TM 11-291

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

MT-297

RADIO SETS
AN/VRC-13
AN/VRC-14
AND
AN/VRC-15

DEPARTMENT OF THE ARMY • MARCH 1951

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CONTENTS

	Paragraph	Page
CHAPTER 1. INTRODUCTION.		
Section I. General	1–3	1
II. Description and data	4–19	3
CHAPTER 2. INSTALLATION INSTRUCTIONS.		
Section I. Introduction	20–21	19
II. Vehicular installation details	22–27	19
III. Equipment installation details	28–34	27
IV. Adjustments for operation	35–36	30
V. Control Group AN/GRA–6 and miscellaneous equipment	37–38	31
CHAPTER 3. OPERATING INSTRUCTIONS.		
Section I. Modes of operation	39–43	36
II. Controls and instruments	44–52	36
III. Operation	53–61	45
CHAPTER 4. THEORY OF OPERATION.		
Section I. Introduction	62–65	50
II. Power distribution and push-to-talk control circuits	66–69	51
III. Operation from Control Group AN/GRA–6	70–74	56
IV. Unit theory	75–79	58
CHAPTER 5. ORGANIZATIONAL MAINTENANCE.		
Section I. Trouble shooting	80–87	65
II. Replacement of parts	88–93	72
CHAPTER 6. AUXILIARY EQUIPMENT.	94–99	82
APPENDIX I. REFERENCES		90
II. IDENTIFICATION TABLE OF PARTS		92
III. RELATED RADIO SETS		102
INDEX		111

WARNING

HIGH VOLTAGE

is used in the operation
of this equipment.

DEATH ON CONTACT

may result if operating personnel fail
to observe safety precautions.

First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4

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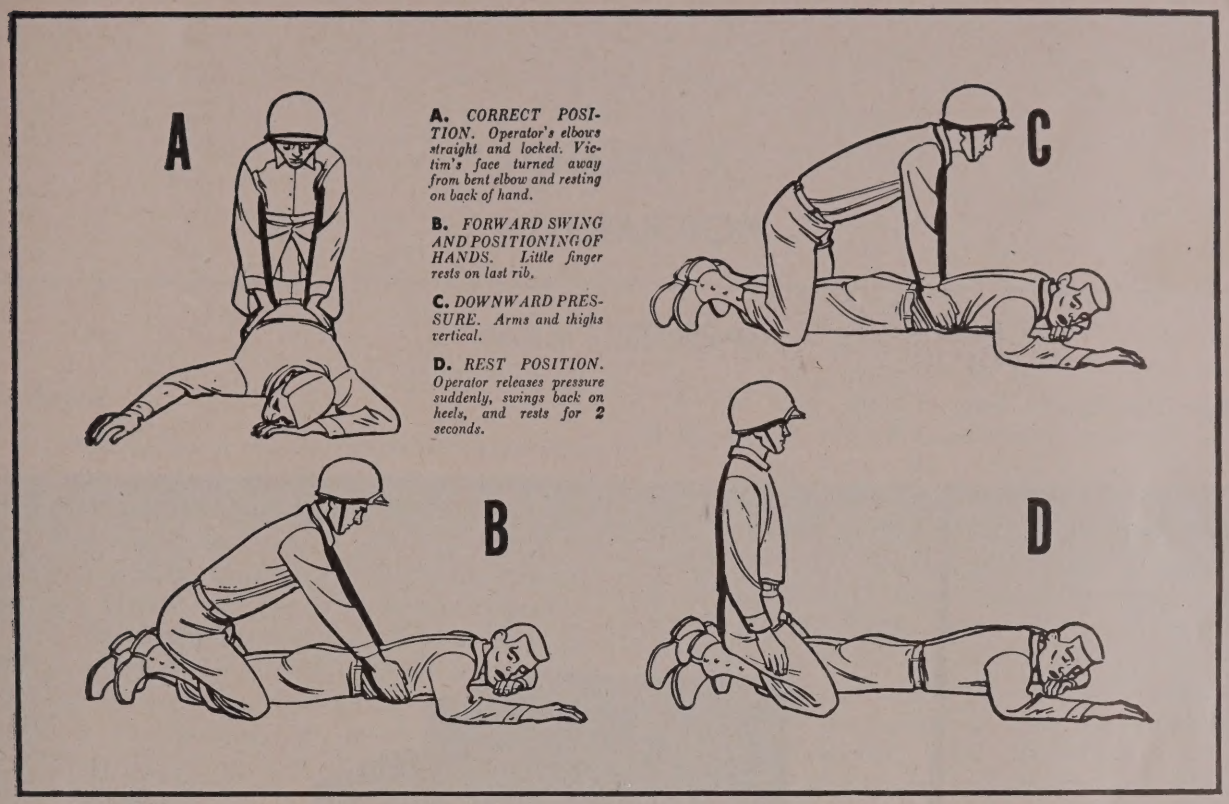


seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. ***Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.***

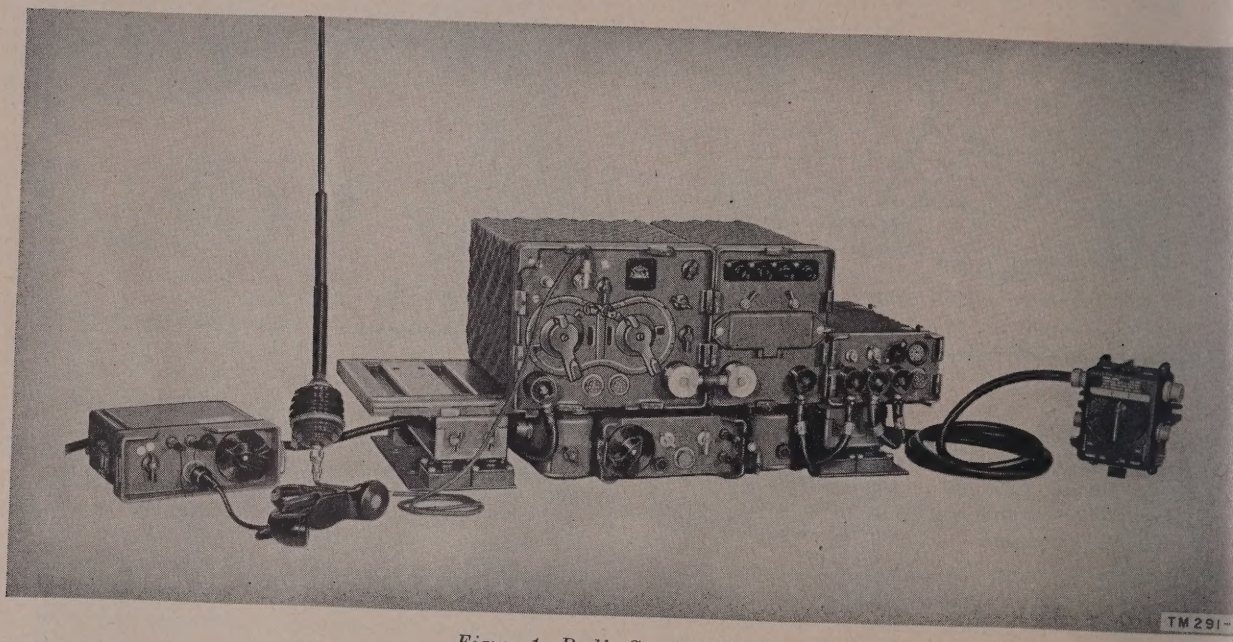


Figure 1. Radio Set AN/VRC–13.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains instructions for the installation, operation, and organizational maintenance of Radio Sets AN/VRC–13, –14, and –15. The information is intended primarily for operators and organizational maintenance personnel and, hence, is restricted to system considerations. Detailed information on the various units which comprise the several systems is presented only so far as system applications are involved. Detailed field maintenance instructions for the individual major components are published in separate manuals.

b. Certain schematic drawings for this equipment are included separately, because of their size, in an envelope following the index. These include figures 18, 40, 41, 71, 72, 76, 77, 78, 79, 80, 81, and 82. To this extent, therefore, figure numbers throughout the manual are not in strict numerical sequence, and whenever the instructions refer to figures, 18, 40, 41, 71, 72, 76, 77, 78, 79, 80, 81, or 82, the illustration will be found in the envelope at the back of the manual.

2. Nomenclature

The basic similarities of Radio Sets AN/VRC–13, –14, and –15 allow simultaneous treatment of these sets in most instances. To expedite this simultaneous treatment, an arbitrary nomenclature has been evised to refer to the sets and their respective units collectively. This expedient is outlined below.

a. The over-all systems, Radio Sets AN/VRC–13, –14, and –15, are referred to collectively as the *radio sets.* Wherever instructions are limited to a particular set or group of sets, specific reference is made to that effect and full nomenclature (for example, Radio Set AN/VRC–13) is used for the set involved.

b. The term *Set 1* is used in this manual to designate the receiver-transmitter included in each of the radio sets. Set 1 may be any one of Receiver-Transmitters RT–66/GRC, RT–67/GRC, or RT–68/GRC. The particular Set 1 which is used in each of the radio sets is listed in paragraph 6. The term *Set 2* refers to Receiver-Transmitter RT–70/GRC, which is not used in this system.

c. The term *Set 1 power supply* is used to designate Power Supply PP–109/GR or PP–112/GR, either of which may be used to supply operating voltages for Set 1 only. The battery voltage available, 12 or 24 volts, determines which power supply must be used (par. 11).

d. AF Amplifier AM–65/GRC, a common component of all the radio sets, is referred to in this manual as the *interphone amplifier.*

e. The term *amplifier power supply* is used in this manual to designate Power Supply PP–281/GRC or PP–282/GRC, either of which is used to supply operating voltage for the interphone amplifier in all of the radio sets. The battery voltage available, 12 or 24 volts, determines which power supply must be used.

f. To identify the various control units of the radio sets in a functional manner, the following terms are used: Control Box C–375/VRC is referred to as the *interphone box;* Local Control C–434/GRC is referred to as the *local control unit;* and Remote Control C–33/GRC is referred to as the *remote control unit.*

3. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army matériel and equipment.

a. DD Form 6, (Report of Damaged or Improper Shipment) will be filled out and forwarded as prescribed in SR 745–45–5.

b. DA AGO Form 468 (Unsatisfactory Equip-

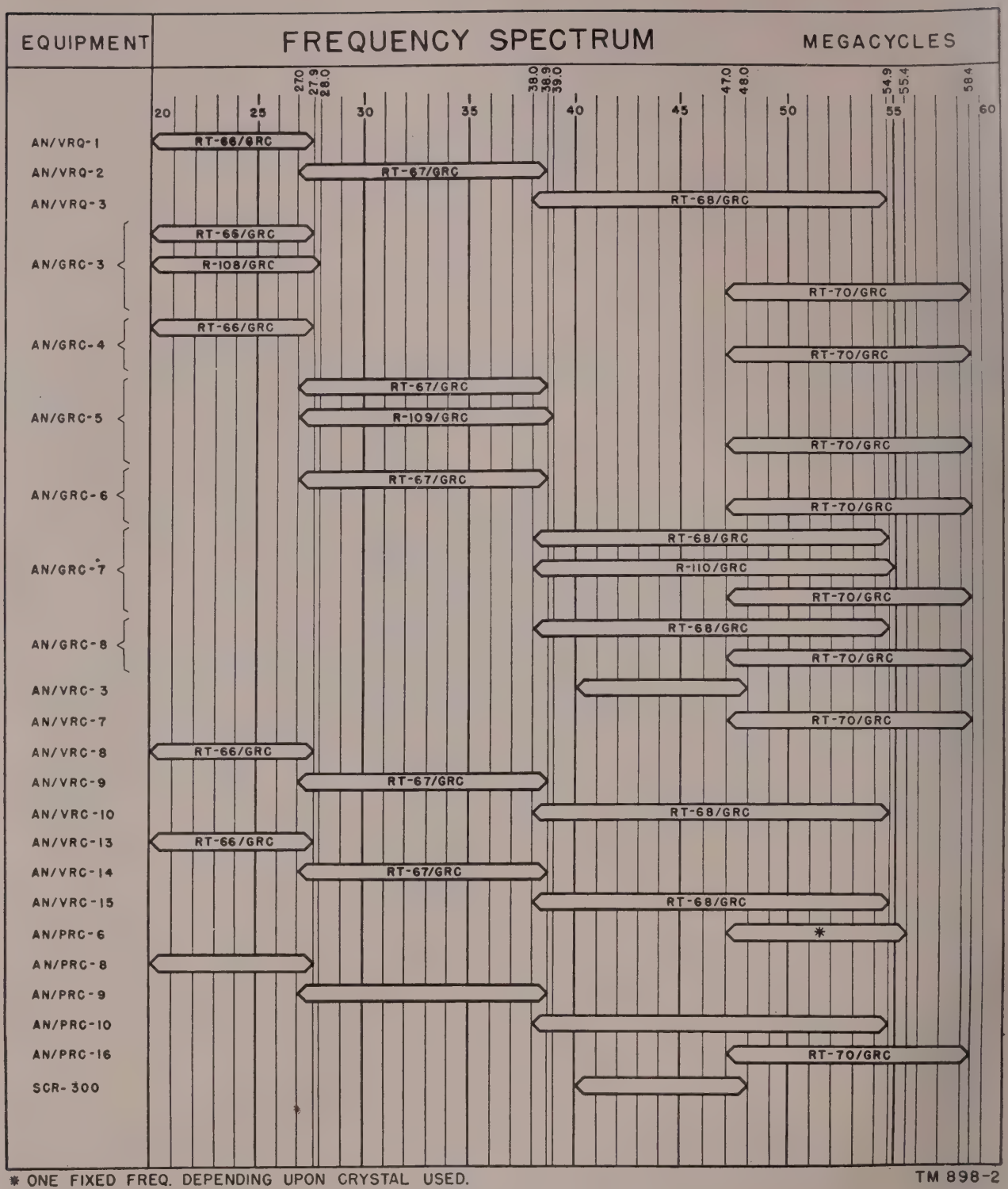


Figure 2. Frequency spectrum chart.

ment Report) will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700–45–5.

c. WD AGO Form 419 (Preventive Maintenance Checklist for Signal Corps Equipment) will be prepared in accordance with instructions on the back of the form.

d. Use other forms an records as authorized.

Section II. DESCRIPTION AND DATA

4. Purpose of Equipment

a. Radio Sets AN/VRC–13, –14, and –15 provide f-m (frequency-modulated) radiotelephone facilities within the frequency range of 20 to 54.9 mc (megacycles). The specific frequency range of each set and other radio equipment with which the sets can communicate is indicated in the frequency spectrum chart (fig. 2). An overlap of .9 mc is provided between the bands covered by Radio Sets AN/VRC–13 and –14. Similarly a .9-mc overlap exists between the bands covered by Radio Sets AN/VRC–14, and –15. The purpose of this overlap is to permit the establishment of liaison between sets that are operated in different tactical groups.

b. The radio sets can be installed and operated in trucks, personnel carriers, tanks, armored vehicles, weapons carriers, and other authorized vehicles (par. 8). Primarily, the sets are designed for short range operation within and between armored, artillery, and infantry units. Specifically, Radio Set AN/VRC–13 is intended for armored use, Radio Set AN/VRC–14 is intended for artillery use, and Radio Set AN/VRC–15 is intended for infantry use.

5. Technical Characteristics

Type of transmission and reception.	Voice and 1600-cycle f-m signals.
Frequency range:	
Radio Set AN/VRC–13	20 to 27.9 mc.
Radio Set AN/VRC–14	27 to 38.9 mc.
Radio Set AN/VRC–15	38 to 54.9 mc.
Type of tuning	Choice of detent, preset channels, or continuous tuning.
Number of detent channels available:	
Radio Set AN/VRC–13	80.
Radio Set AN/VRC–14	120.
Radio Set AN/VRC–15	170.
Number of preset detented channels.	2.
Detent channel spacing	100 kc (kilocycles).
Communication range:	
Vehicles in motion	10 miles, approximately.
Stationary vehicles	15 miles, approximately
Type of transmission and reception—Continued.	Voice and 1600-cycle f-m signals—Continued.
Antenna requirements	One whip type serves both the transmitter and the receiver circuits.
Antenna circuit tuning	Transmitter antenna circuit tunable at 1-mc intervals for a particular antenna installation by means of antenna tuning control. After adjustment, tuning is automatic for all channels. Receiver antenna circuit tuned at one frequency for use over frequency range.
Receiver bandwidth	Approximately 80 kc, 6 db (decibel) down.
Receiver sensitivity	30-db signal-plus-noise to noise ratio with ½-μ (microvolt) input signal.
Types of operation	(1) Standard push-to-talk single frequency operation. (2) Remote push-to-talk and power control operation up to a distance of approximately 2 miles using the AN/GRA–6. (3) Simple telephone circuit operation between the remote and local positions. (4) Interphone operation between various points in an installation.
Total power drain	From 60 to 230 watts depending upon the mode of operation.
Unit power drains:	
Receiver-transmitter:	
12.6-volt input	Input 2.3 amperes on standby and 11.9 amperes on transmission.
25.2-volt input	Input 1.5 amperes on standby and 7.3 amperes on transmission.
Interphone amplifier:	
12.6-volt input	Input 2.6 amperes on standby, and 3.2 amperes on transmission.
25.2-volt input	Input 1.4 amperes on standby, and 1.8 amperes on transmission.
Transmitter r-f (radio-frequency) power output.	16 watts on HIGH power; 2 watts on LOW power.

Type of transmission and reception—Continued.	Voice and 1600-cycle f-m signals—Continued.
Receiver a-f (audio-frequency) power output.	Approximately 1 watt and 50 mw (milliwatts) at speaker and phone output terminals respectively; approximately 30 mw at fixed level output terminals. (Input to interphone amplifier.)
Interphone a-f power output:	
Set 1 + Set 2 + Interphone.	1800 mw.
Set 1 + Interphone	350 mw.
Set 2 + Interphone	350 mw.
Microphone input impedance.	150 ohms.
Type of transmission and reception—Continued.	Voice and 1600-cycle f-m signals—Continued.
Audio output impedance	150 ohms at Set 1 + Set 2 + Interphone output of interphone amplifier; 600 ohms at all other output terminals.

6. Table of Components

A composite table of components for all of the radio sets is presented below. All dimensions and weights are approximate. The table includes components of the basic sets only. For installation and operation in particular vehicles, the additional equipment listed in paragraph 8 is also required.

Component	No. for radio sets			Dimensions				
	Radio Set AN/VRC-13	Radio Set AN/VRC-14	Radio Set AN/VRC-15	Height (in.)	Depth (in.)	Width (in.)	Volume (cu ft)	Unit weight (lb)
Receiver-Transmitter RT-66/GRC	1			9	13	11¼	0.76	35
Receiver-Transmitter RT-67/GRC		1		9	13	11¼	.76	35
Receiver-Transmitter RT-68/GRC			1	9	13	11¼	.76	35
AF Amplifier AM-65/GRC	1	1	1	4¼	13	7⅞	.30	15.5
Power Supply PP-281/GRC or PP-282/GRC	1	1	1	4½	6	3	.04	6
Power Supply PP-109/GR or PP-112/GR	1	1	1	9	13	7¼	.54	35
Control Box C-375/VRC	1	1	1	8	4	7	.1	3.5
Local Control C-434/GRC	1	1	1	3½	10½	8¾	.18	8
Remote Control C-433/GRC	1	1	1	3½	9⅜	7	.13	5
Handset H-33/PT	1	1	1	3	2 3/64	7⅞	.03	2
Bag CW-189/GR	1	1	1	11	10⅝	7¾		1
Mounting MT-297/GR	1	1	1	5	12	34	1.06	50
Adapter UG-273/U	1	1	1				.006	.34
Adapter UG-306/U	1	1	1	7/16 (diam)		1	.006	.36
Bag CW-206/GR	1	1	1	3 (thk)	5 (wd)	40	.34	3.5
Special Purpose Cable WM-46/U	1	1	1	.6 (diam)		120	.4	.9
RF Cable Assembly CG-568/U	1					50	.01	.5
RF Cable Assembly CG-530/U		1	1			50	.01	.5
Special Purpose Cable Assembly CX-1211/U	1	1	1				.25	.5
Case CY-684/GR	1	1	1				.17	3
Connector and bandnut, Appleton Electric Company No. 61007 and BL-50, or equal	1	1	1				.01	.3
Mast Section MS-116-A	2	2				39.5	.0461	.6
Mast Section MS-117-A	2	2	2			39.5	.042	1.4
Mast Section MS-118-A	2	2				39.5	.016	.5
Mast Section AB-24/GR			2			23.5	.003	.13
Mast Base AB-15/GR	1	1	1	15				2
Technical manual (TM 11-291)	2	2	2				.08	1

7. Packaging Data

The basic components of each of the radio sets (par. 6) are packed for shipment in three wooden boxes. First, the components are packaged individually in moisture-vaporproof containers and then distributed in three wooden boxes. Weights and volumes of the three over-all containers are listed in *a* below; the contents of each box are listed in *b* below.

Note. Items may be packaged in a manner different from that shown, depending on the supply channel.

a. Weight and Volume of Boxes. The weights and volumes of the three wooden boxes are as follows:

Box	Weight (lbs)	Volume (cu ft)
1	100	2. 00
2	129	4. 10
3	108	2. 49
Total	337	8. 59

b. Contents of Each Box for Radio Sets AN/VRC–13, –14, and –15. The contents of boxes No. 1, 2, and 3 are the same for all three radio sets except for the one difference in each box noted in the following table.

Box No.	Contents	Quan.	Notes
1	Receiver-Transmitter RT–66/GRC	1	Supplied with AN/VRC–13 only.
	or		
	Receiver-Transmitter RT–67/GRC	1	Supplied with AN/VRC–14 only.
	or		
	Receiver Transmitter RT–68/GRC	1	Supplied with AN/VRC–15 only.
	Power Supply PP–109/GR	1	PP–109/GR supplied for 12-volt systems.
	Power Supply PP–112/GR	1	PP–112 for 24-volt systems.
2	Mast Base AB–15/GR	1	
	Mast Section MS–117–A	2	
	Mast Section AB–24/GR	2	Supplied with AN/VRC–15 only.
	Mast Section MS–118–A	2	Supplied with AN/VRC–13 and AN/VRC–14 only.
	and		
	Mast Section MS–116–A	2	
	Control Group AN/GRA–6	1	
	Adapter UG–273/U	1	
	Adapter UG–306/U	1	
	Special Purpose Cable Assembly CX–1211/U	1	
	Bag CW–206/GR	1	
	Case CY–684/GR	1	
	Technical manual (TM 11–291)	2	
	AF Amplifier AM–65/GRC	1	
	Power Supply PP–281/GRC	1	PP–281/GRC supplied for 12-volt systems.
	or		
	Power Supply PP–282/GRC	1	PP–112/GR for 25-volt systems.
3	Cable WM–46 ( )/U	10 ft	
	Control Box C–375/VRC	1	
	Mounting MT–297/GR	1	
	Cable Assembly CG–568/U	1	CG–568/U supplied with AN/VRC–13 only.
	Cable Assembly CG–530/U	1	CG–530/U supplied with AN/VRC–14 and –15 only.

8. Additional Equipment Required

a. To install and operate any of the radio sets, both a basic unit (par. 6) and an installation unit are required. The basic unit is common to all installations; the installation unit varies with the type of vehicle for which the installation is intended. Such items as audio accessories, control boxes, cable lengths, junction boxes, and mounting hardware vary from vehicle to vehicle. For this reason, a separate installation unit is supplied for each vehicular installation. Table I gives the stock numbers used in requisitioning the installation unit, basic unit, and the complete equipment.

b. The audio accessories for the radio sets (any of which may be supplied depending upon the installation) are described in paragraph 18. The remaining contents of the installation units are not listed in detail.

c. In addition to the equipment included in basic units and installation units, the following dry cells are required for operation (par. 37).

Four 1½-volt Batteries BA–30.
One 45-volt Battery BA–414/U.

Table I. Vehicular Installation Units

Radio set	Type of vehicle	Stock No.		
		Complete equipment	Basic unit	Installation unit
AN/VRC–13	Light Armored Car M8	2S4502–13–V17	2S4502–13/12	2S2501–3–V17/50
AN/VRC–13	75-mm Gun Motor Carriage M18	2S4502–13–V65	2S4502–13/24	2S4502–13–V65/5
AN/VRC–13	Armored Utility Vehicle M39	2S4502–13–V91	2S4502–13/24	2S2501–3–V91/50
AN/VRC–14	Light Armored Car M8	2S4502–14–V17	2S4502–14/12	2S2501–3–V17/50
AN/VRC–14	76-mm Gun Motor Carriage M18	2S4502–14–V65	2S4502–14/24	2S4502–13–V65/5
AN/VRC–14	Armored Utility Vehicle M39	2S4502–14–V91	2S4502–14/24	2S2501–3–V91/50
AN/VRC–15	Light Armored Car M8	2S4502–15–V17	2S4502–15/12	2S2501–3–V17/50
AN/VRC–15	75-mm Gun Motor Carriage M18	2S4502–15–V65	2S4502–15/24	2S4502–13–V65/5
AN/VRC–15	Armored Utility Vehicle M39	2S4502–15–V91	2S4502–15/24	2S2501–3–V91/50

Note. This table is subject to changes in vehicle types.

9. General System Description

a. Introduction. Radio Set AN/VRC–13 (fig. 1) is typical of all the sets discussed in this manual. The nomenclature outlined in paragraph 2 and the table of components (par. 6) will facilitate adaptation of the following general description to any particular radio set. The system cordage diagram (fig. 28), which is essentially a composite illustration of all sets, is also helpful in the understanding of the various systems.

b. Common Components (fig. 3). All of the basic radio sets have the following items in common:

(1) One receiver-transmitter, an interphone amplifier, and suitable power supplies.
(2) A mounting.
(3) Three control units.
(4) Suitable antenna systems and interconnecting cables.

c. Radio Set AN/VRC–13. Figure 1 shows the major components of Radio Set AN/VRC–13 connected to simulate a 24-volt operating installation. Receiver-Transmitter RT–66/GRC is utilized as Set 1; Power Supply PP–112/GR furnishes operating voltages for Set 1; and AF Amplifier AM–65/GRC serves as the interphone amplifier. Operating voltage for the amplifier is furnished by a plug-in power supply unit (Power Supply PP–282/GRC) contained within the amplifier. All of the above-mentioned units are secured on Mounting MT–297/GR which is normally bolted to a vehicular mounting surface. The mounting also accommodates one of the control units (Local Control C–434/GRC) as a plug-in unit with electrical connections. From the mounting, connections are made to the vehicular battery, to the major units supported on the mounting, and to Control Box C–375/VRC. When the local control unit is plugged into the mounting as shown, connection is made to Remote Control C–433/GRC by telephone wire. Connections to the antenna system are made directly from the panel of Set 1 (fig. 28).

d. 12-Volt System. The system described above is applicable to vehicles which have a 24-volt storage battery. To operate the system from a 12-volt storage battery, Power Supplies PP–109/GR and PP–281/GRC must be substituted for Power Supplies PP–112/GR and PP–282/GRC, respectively. Either installation constitutes a basic Radio Set AN/VRC–13.

e. Radio Sets AN/VRC–14 and –15. If Receiver-Transmitter RT–67/GRC or RT–68/GRC is used as the radio set, and the antenna system for the set is changed as indicated in figure 28, the basic installation becomes Radio Set AN/VRC–14 or Radio Set AN/VRC–15. Each basic set has its own stock number as indicated in table I, which must be used in requisitioning a particular set. Note the different stock numbers for 12- and 24-volt supplies.

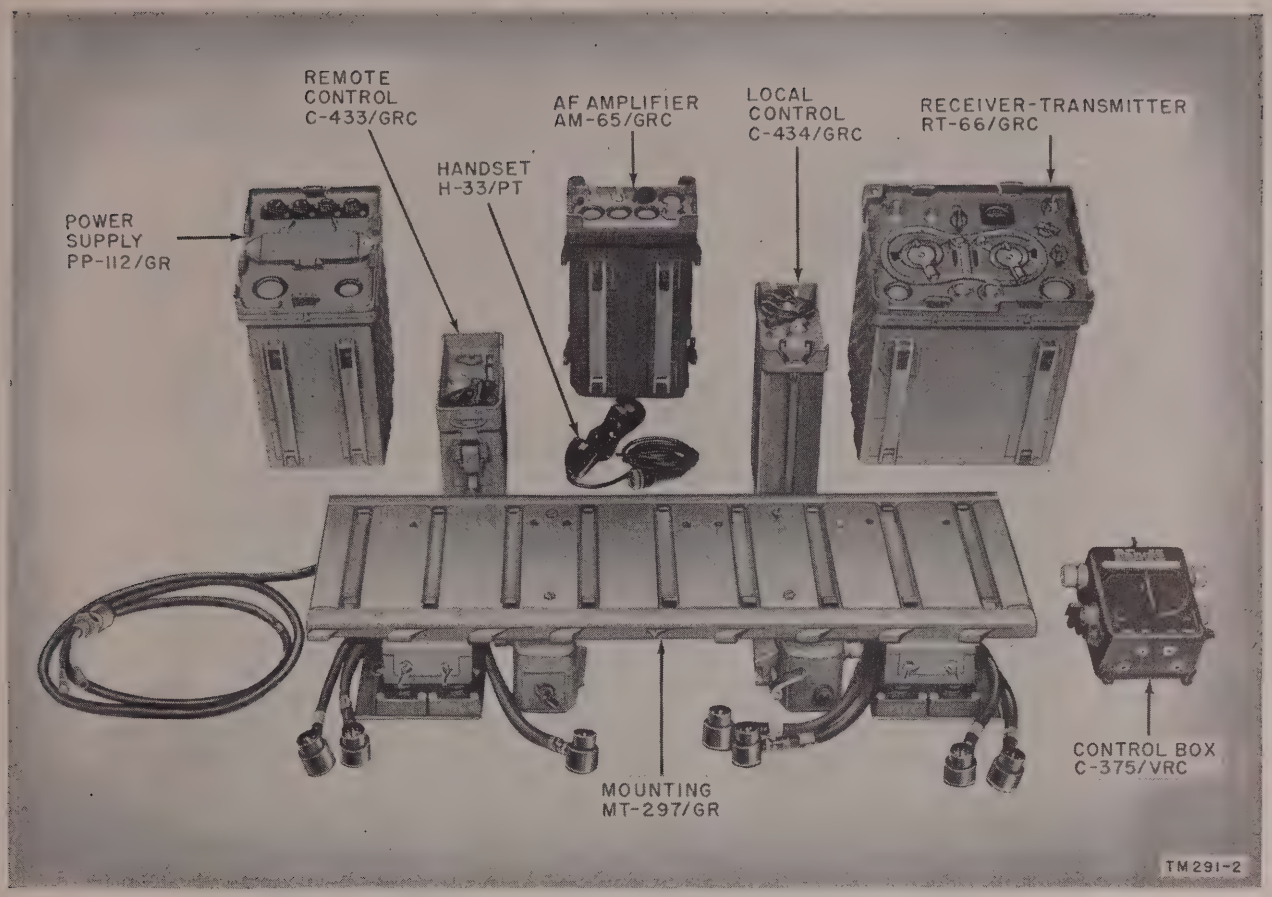


Figure 3. Common components of Radio Sets AN/VRC–13, –14, and –15.

f. Summary. The essential difference between the radio sets is the receiver-transmitter used as Set 1. This in turn depends upon the frequency range desired for operation. Paragraph 10 indicates which set is used with each system, and paragraph 5 shows the frequency range for each system.

10. Set 1 Receiver-Transmitter

a. One of Receiver-Transmitters RT–66/GRC, RT–67/GRC, RT–68/GRC is used as Set 1 in each of the radio sets described in this manual. The particular system in which each of the receiver-transmitters is used is as follows: RT–66/GRC is used in AN/VRC–13; RT–67/GRC is used in AN/VRC–14; and RT–68/GRC is used in AN/VRC–15.

b. The Set 1 receiver-transmitters are very similar in structure, function, and detailed circuit and mechanical arrangement; they differ from each other only in their operating frequency range and in the components which determine the frequency range. Hence, Receiver-Transmitter RT–66/GRC (fig. 4) is similar externally to the other receiver-transmitters except for the calibrations of the tuning dial and nameplate designation. Characteristics pertinent to system operation are listed in paragraph 5; complete information on the receiver-transmitters is contained in a separate technical manual.

c. Each Set 1 consists of a double-conversion type, superheterodyne f-m receiver and f-m transmitter which use a common antenna. The tuning mechanism of each receiver-transmitter is detented at every 100 kc of its frequency range to provide the channel selections indicated in the following chart. In addition to the detent selections, any two of the channels may be preset (par 51) to allow rapid selection, or the detent mechanism can be disengaged to allow continuous tuning.

Receiver-transmitter	Frequency coverage	No. of channels
RT–66/GRC	20 to 27.9 mc	80
RT–67/GRC	27 to 38.9 mc	120
RT–68/GRC	38 to 54.9 mc	170

d. Mechanically, the receiver-transmitters are panel-chassis assemblies inclosed in a metal case (fig. 4). The bottom of the case is fitted with channel rails which are used to secure the unit to the vehicular mounting (par. 32). When the case is removed, the r-f and i-f (intermediate-frequency) chassis assemblies are available at either side of the unit (figs. 52, 53, and 54). All tubes are mounted on these vertical chassis.

e. In vehicular installations, Set 1 is installed on Mounting MT–297/GR (fig. 1) and is powered by a vehicular power supply such as Power Supply PP–112/GR.

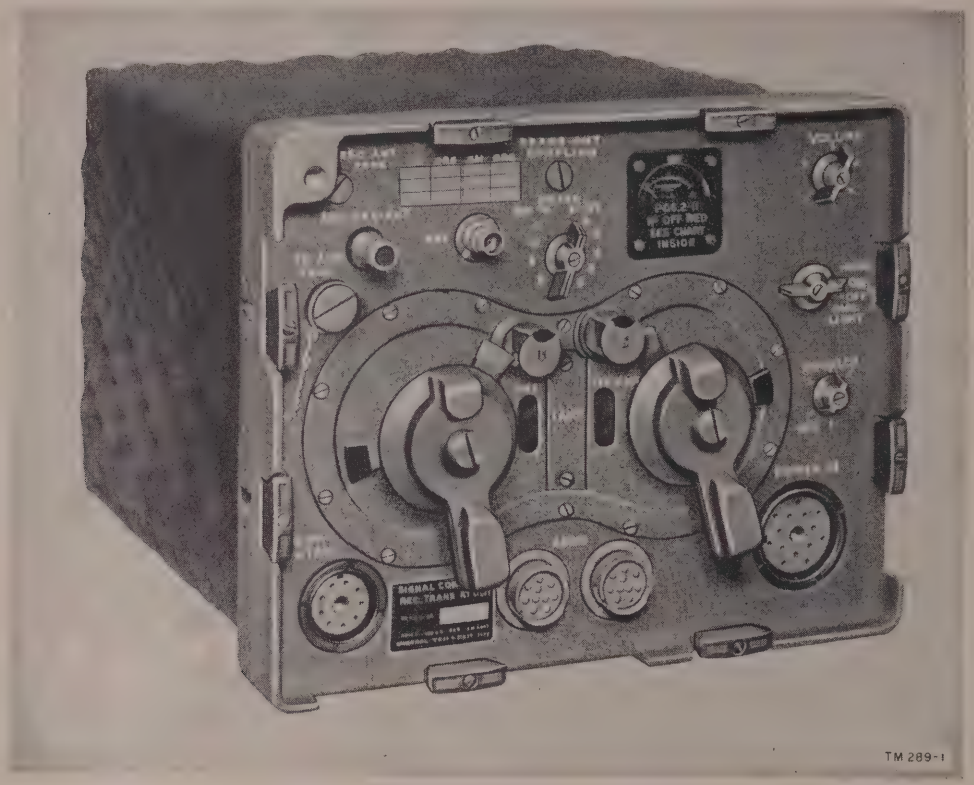


Figure 4. Receiver-Transmitter RT–66/GRC.

11. Set 1 Power Supply

a. Either Power Supply PP–109/GR or PP–112/GR is used to furnish operating plate and screen voltages for Set 1, depending on whether the vehicular storage battery supplies 12 or 24 volts, respectively. The two units are similar externally (fig. 5) and differ internally only in those circuits necessary to convert the battery voltage to the proper operating voltage for the receiver-transmitter. Detailed information on the power supplies is contained in a separate technical manual.

b. The power supply develops plate, screen, bias, filament, microphone, and relay potentials for the receiver-transmitter. The plate, screen, and bias voltages are developed by a vibrator type power supply circuit. Input battery voltage is supplied through a POWER IN receptacle on the front panel (fig. 5), and all output voltages are available at the POWER OUT receptacle on the front panel.

c. Mechanically, the power supply units are panel-chassis assemblies inclosed in a metal case. Channel rails on the bottom of the case permit installation of the case on Mounting MT–297/GR. When the case is removed (figs. 49, 50, and 51), the replaceable parts on the chassis are accessible.

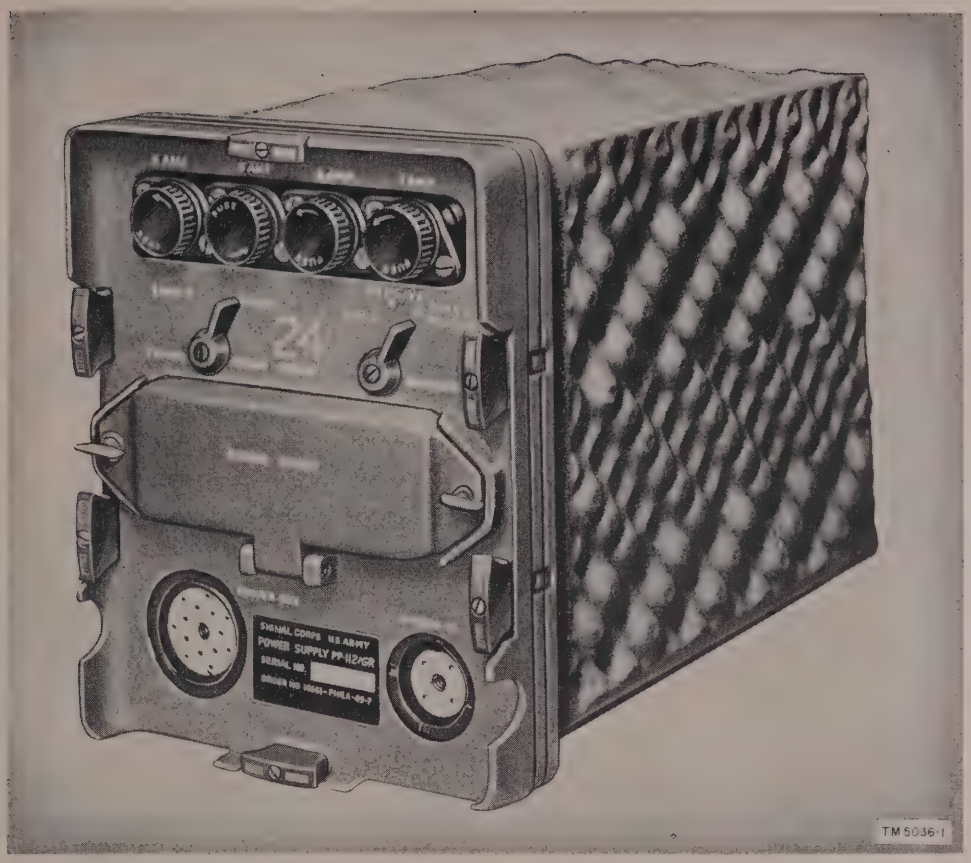


Figure 5. Power Supply PP–112/GR, front view.

12. AF Amplifier AM–65/GRC

a. AF Amplifier AM–65/GRC (fig. 6) is a common component of all the radio sets described in this manual. Generally referred to as the interphone amplifier, this unit serves a dual purpose, providing not only for intercommunication between control boxes but also for monitoring the receiver-transmitter. Detailed information on the amplifier is contained in a separate technical manual.

b. Electrically, the interphone amplifier is a three-channel electronic mixer and a-f amplifier. The three channels provide a *Set 1+Interphone* output, a *Set 1+Set 2+Interphone* output, and a *Set 2+Interphone* output. The interphone signal predominates on the Set 1+Set 2+Interphone channel; the signals from receiver-transmitters are equal in strength to the interphone signal on the other two channels.

Note.—Since Set 2 is not used in this installation, the third channel carries only the interphone signal.

c. Mechanically, the interphone amplifier is a panel-chassis assembly inclosed in a metal case. Channel rails on the bottom of the case permit the installation of the unit on Mounting MT–297/GR. When the case is removed (fig. 47), all replaceable parts are accessible.

d. A compartment within the amplifier (fig. 47) accommodates a plug-in power supply unit (Power Supply PP–281/GRC or PP–282/GRC for 12- and 24-volt operation, respectively) which supplies operating plate and screen voltages for the amplifier.

13. Mounting MT–297/GR

a. Mounting MT–297/GR (fig. 7) serves as a support for major units of the radio sets and as a junction box for interconnecting various units. Figures 1 and 18 demonstrate the dual function of the mounting.

b. At either end of the mounting are two shock-mounted supports which normally are bolted to a vehicular mounting surface. A hinged mounting table is secured to these supports and a junction box is suspended from the under surface of the table near the center of the unit (fig. 7).

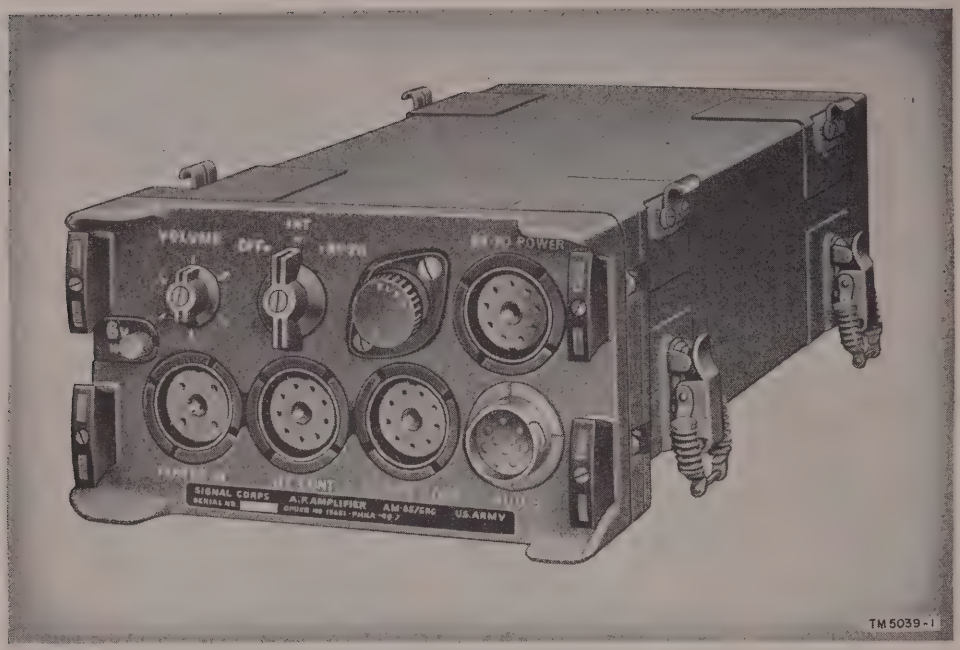


Figure 6. AF Amplifier AM–65/GRC.

c. The mounting table is channeled to accept the rails on the bottom of the Set 1 receiver-transmitter, the Set 1 power supply, and the interphone amplifier. Locking levers are provided on the front edge of the mounting table to secure the units on the table.

d. The junction box at the center of the unit contains the terminal boards and electrical circuits which serve to interconnect the units in an operating system (fig. 19). Cables are provided on either side of the junction box to connect the mounting to the vehicular battery and to the major units. Each cable is tagged to facilitate proper interconnection. A receptacle on the rear inner surface of the junction box serves to accommodate Local Control C–434/GRC and make electrical connections; a lever on the right side of the junction box serves to lock the control unit in the receptacle to effect a watertight connection.

e. Figure 19 shows the mounting table swung back on its hinges and the cover plates removed from the junction box so that access may be had to the interior of the junction box for installation and maintenance purposes.

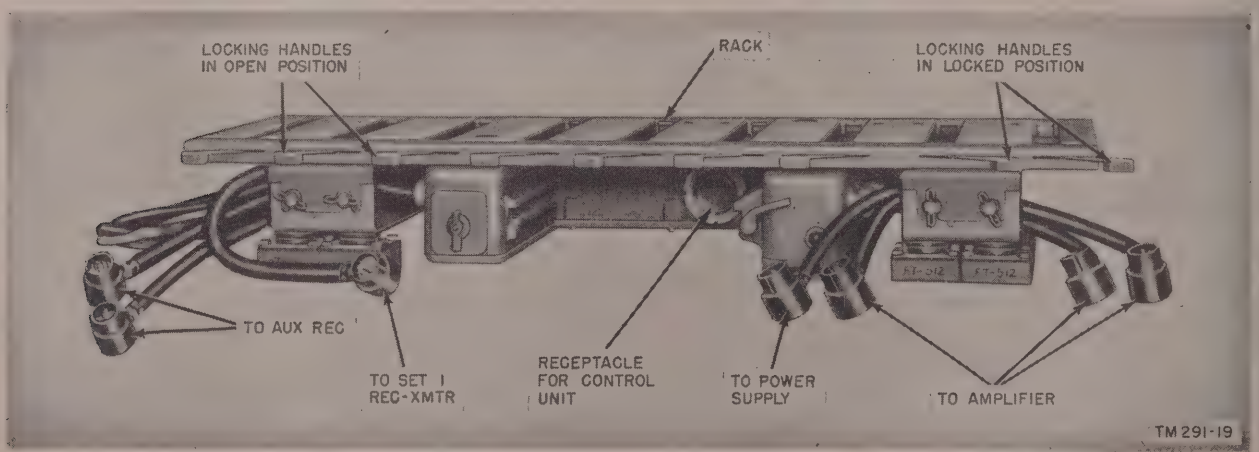


Figure 7. Mounting MT–297/GR, top view.

14. Control Box C–375/VRC

a. One or more of Control Boxes C–375/VRC (fig. 8) is used in every installation of the radio sets described in this manual. One unit is supplied with the basic radio set; additional units may be supplied in the installation kits (par. 8).

b. Control Box C–375/VRC is a remote junction point and switching unit for the control and audio lines to Set 1 and the interphone amplifier. Switches on the control box may connect any of these lines to the 10-pin audio connections on either side of the box (figs. 55 and 56) and to the MIC. and PHONE jacks on the bottom of the box (fig. 56).

Figure 8. Control Box C–375/VRC.

c. Normally, the control boxes are installed at some distance from Mounting MT–297/GR (in locations convenient for the driver, gunner, commander, or other operator) and are connected to the mounting either directly or indirectly by means of Special Purpose Cable WM–46/U. Cable entries are provided at either side of the control box (figs. 55 and 56).

15. Control Group AN/GRA–6

(fig. 9)

a. Control Group AN/GRA–6 may be used to provide local and remote push-to-talk control and local or remote control of power for the radio set and includes provisions for telephone communication between local and remote control stations. The control group includes Local Control C–434/GRC, Remote Control C–433/GRC, Handset H–33/PT, and Bag CW–189/GR. Complete information on the control group is contained in a separate technical manual.

b. Local Control C–434/GRC may be plugged into Mounting MT–297/GR or it may be connected directly to the panel of Set 1 and/or the interphone amplifier by means of a plug-terminated cord at the rear of the unit (fig. 30). The switching facilities of the unit allow for push-to-talk transmission from a handset plugged into the AUDIO connector on the front panel.

Note. It is possible to obtain remote interphone operation and push-to-talk control of Set 1 by plugging the audio connectors, P–1 and P–2, at the rear of the local control, into the front panels of the interphone amplifier and Set 1.

c. Remote Control C–433/GRC may be as far as 2 miles removed from the local unit. A two-wire through metallic telephone line is used to

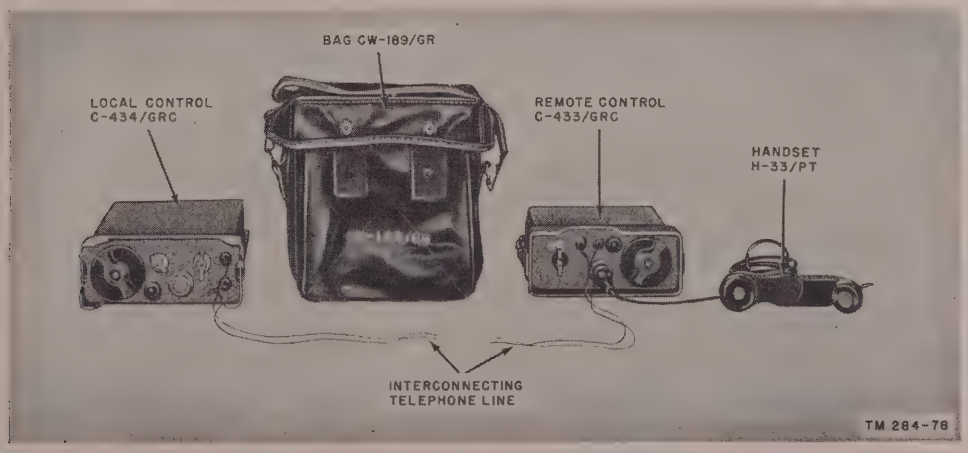


Figure 9. Control Group AN/GRA–6.

interconnect the two units. The combined switch actions of the two units make it possible to extend both power control and push-to-talk facilities to the remote unit. The remote unit will also accommodate a handset.

d. Handset H–33/PT may be used at the panel AUDIO connector of either control unit. The handset is equipped with a push-to-talk, nonlocking, spring return switch which incorporates two electrically independent SPST (single-pole, single-throw) switches. The handset cord is terminated in a 10-pin connector which will mate with the receptacles on the panels of the control unit.

e. Provisions for simple telephone communication (including ringing) are also incorporated in the control units. This facility makes the control group adaptable for field telephone usage.

f. Bag CW–189/GR is provided for storing and carrying purposes. The units may be stored in the bag when they are not used or when they are being transported.

16. Power Supplies PP–281/GRC and PP–282/GRC

Power Supply PP–282/GRC (shown with the minor components in fig. 10) is used in the interphone amplifier in 24-volt installations of the radio set. The unit supplies plate and screen operating voltage for the interphone amplifier. Power Supply PP–281/GRC, similar in appearance and general characteristics, is used for 12-volt installations. The units are vibrator type power supplies which plug into the compartment on the amplifier chassis (fig. 47).

17. Minor Components

a. The following minor components are illustrated in figure 10.

(1) Mast Base AB–15/GR.
(2) Mast Sections MS–116–A, MS–117–A, and MS–118–A.
(3) Mast Section AB–24/GR.
(4) Adapters UG–273/U and UG–306/U.
(5) RF Cable Assembly CG–568/U.
(6) RF Cable Assembly CG–530/U.
(7) Special Purpose Cable Assembly CX–1211/U.
(8) Special Purpose Cable WM–46/U.
(9) Connector and bondnut, Appleton Electrical Company No. 61007 and BL–50, or equal.
(10) Case CY–684/GR.
(11) Bag CW–206/GR.

Note. With the exception of the last three items listed, all of the above components are represented functionally on the system cordage diagram (fig. 28). For physical and electrical descriptions, refer to the indentification table of parts in appendix II.

b. The connector and bondnut are used for connecting the power cable of the radio set (W–8 on fig. 28) to the vehicular power terminal box. The connector is of the feedthrough type, and the bondnut locks the connector in place.

c. Case CY–684/GR is a metal box provided for the storage of running spares. Compartments are provided for tubes, lamps, fuses, and other replaceable parts. The case will not accommodate all of the running spares which are supplied with the various units (par. 19), but will accommodate some of each type. Refer to paragraph 38 for recommendations on the selection of spares to be stored in Case CY–684/GR.

d. Bag CW–206/GR is provided for the storage of spare antenna mast sections, Case CY–684/GR, audio accessories (not in use), and technical manuals.

18. Audio Accessories

a. Type. Audio accessories for operating the radio sets are supplied in the installation units and vary in type and number according to the type of vehicular installation. Some or all of the following items may be supplied.

(1) Chest Set Group AN/GSA–6 and Headset-Microphone H–63/U.
(2) Dynamic Loudspeaker LS–166/U.
(3) Handset H–33/PT.
(4) Microphone M–29/U.
(5) Headset, Navy type CW–49507 and Headset Cord CX–1334/U.

Note. The above-listed audio accessories are the only types which can be connected to the 10-pin audio connectors on the radio sets. Control Box C–375/VRC is the only unit equipped with jacks which will accommodate any substitute accessories (*h* below).

b. Chest Set Group AN/GSA–6. Chest Set Group AN/GSA–6, in conjunctions with Headset-Microphone H–63/U (*c* below), is the audio accessory most commonly used with the radio sets. The chest set group consists of a chest-mounting switch box and a 5-foot cord which terminates in an eight-contact receptacle and a 10-pin audio

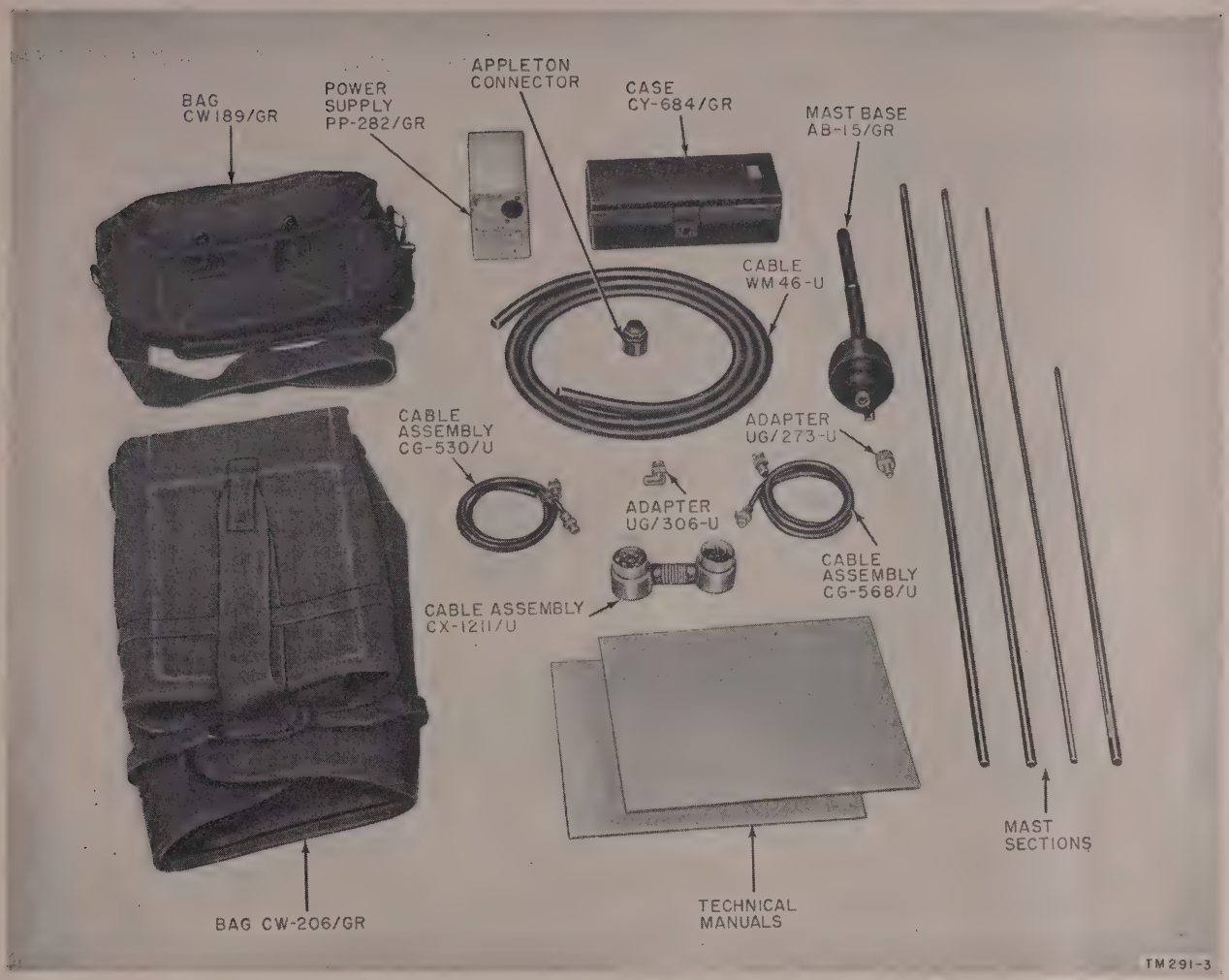


Figure 10. Minor components of Radio Set AN/VRC–13.

connector. The receptacle mates with the plug on one end of the switch box and may be disconnected quickly. The audio connector will mate with any of the 10-pin connectors on the control units, the receiver-transmitter, and the interphone amplifier. Two plugs provided on the switch box will mate with the jacks on Headset-Microphone H–63/U. Two push - button switches labeled HOLD ON and LOCK ON, both for push-to-talk operation, are provided on one side of the switch box; a push-button RADIO switch is provided on the other side of the box. The LOCK-ON push-button switch remains down when depressed until the HOLD-ON switch is depressed. The HOLD-ON switch is spring returned when released. The LOCK-ON switch may be disabled in the following manner: Unscrew the screws holding the cover to the body of the chest set and lift the cover from the body (fig. 11). Be careful not to damage the gasket. Determine the location of the lock to be used from figure 12. Loosen the screw holding the lock to the chassis in the chest set, until the LOCK-ON locking device may be lifted and turned. Rotate the device in a counterclockwise direction until the peg at the base of it falls into the hole shown in figure 12. Tighten the screw, securing the locking device in place. To place the LOCK-ON feature back in operation, reverse the procedure given above. The push-button switch is normally in the interphone position, allowing for interphone operation when only the push-to-talk switch is pressed. (This is true only when the chest set is connected to Control Box C–375/VRC, which is wired for interphone operation.) Radio transmission is accomplished by pressing both the RADIO push-button and one of the push-to-talk switches. The push-button may be locked in either position as follows: Remove the cover and

Figure 11. Chest Set Group AN/GSA–6, assembled.

locate the lock in the same manner as described above. To lock it in the interphone position, slide the locking mechanism toward the top of the chest set without depressing the RADIO push-button. To lock it in the RADIO position, first depress and hold the push-button and then slide the lock toward the top of the chest set.

c. Headset-Microphone H–63/U. Headset-Microphone H–63/U (fig. 13) consists of two series-connected 300-ohm receivers and a 40- to 150-ohm microphone. The microphone is mounted on an adjustable boom attached to the receiver headband. Two 14-inch conductors from the microphone and headset are terminated in two-pin and three-pin jacks, respectively. These jacks will mate with the plugs on Chest Set Group AN/GSA–6.

d. Dynamic Loudspeaker LS–166/U. Dynamic Loudspeaker LS–166/U (fig. 14) is a 4-inch, permanent magnet field, dynamic type loudspeaker with a voice-coil impedance of 8 ohms, and a 600-ohm impedance input transformer. A 5-foot cord, terminated in a 10-pin audio connector, is provided for connecting the speaker to the audio receptacles wired for loudspeaker or phone operation. A rotary switch on the side of the speaker may be used to switch units from speaker to phone output.

e. Handset H–33/PT. Handset H–33/PT (fig. 15) is a combination microphone and a receiver with a push-to-talk switch and connecting cord. The microphone impedance is 40 ohms; the receiver impedance is 300 ohms. The push-to-talk switch provided consists of two electrically independent SPST switches. The cord is 5 feet long and is terminated in a 10-pin audio connector which will mate with the audio connectors on the receiver-transmitter, the interphone amplifier, and the control units.

f. Microphone M–29/U. Microphone M–29/U (fig. 16) consists of a 40- to 100-ohm carbon microphone element in a plastic case with a push-to-talk switch and connecting cord attached. The push-to-talk switch incorporates two electrically independent SPST switches. The connecting cord is 5 feet long and terminates in a 10-pin audio connector which will mate with the connectors on the receiver-transmitters, the interphone amplifier, and the control units.

g. Headset Navy Type CW–49507 and Head-

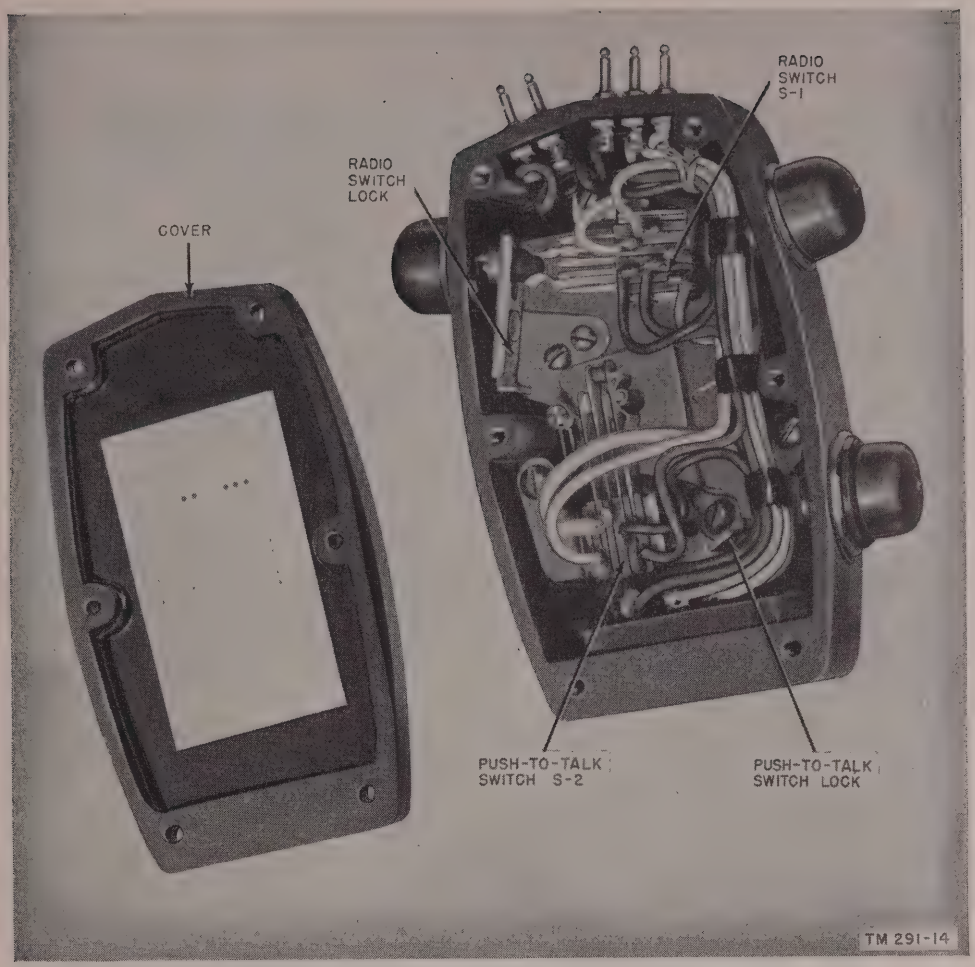


Figure 12. Chest Set Group AN/GSA–6, open view.

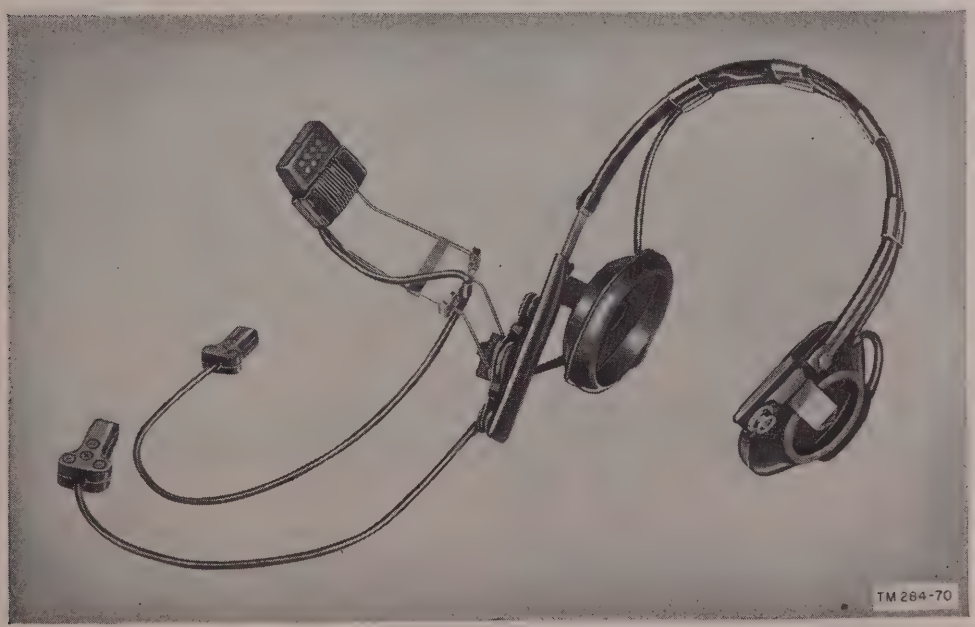


Figure 13. Headset-Microphone H–63/U

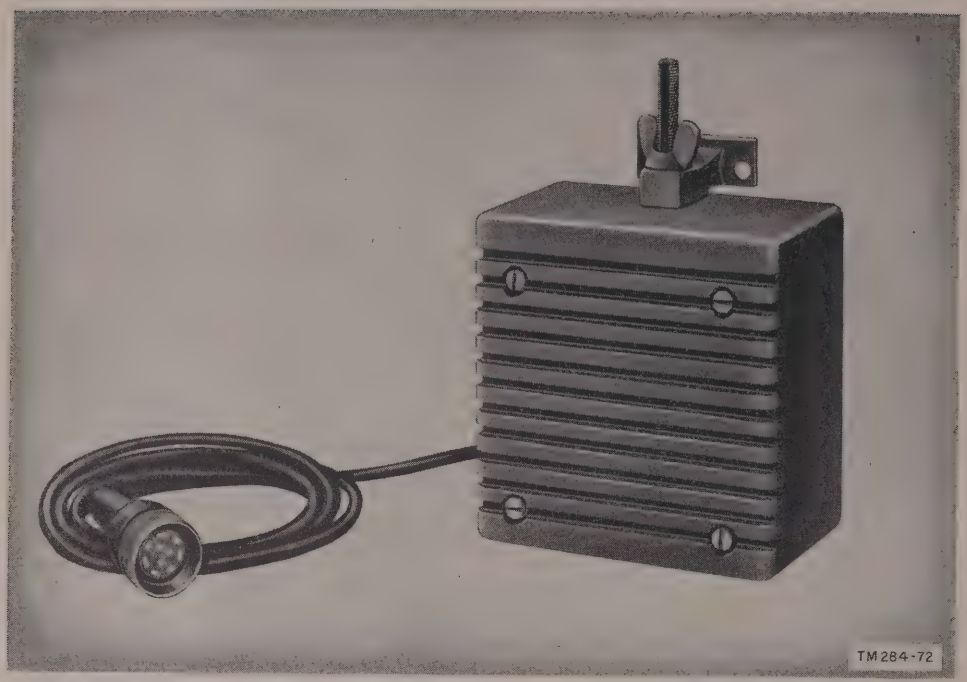


Figure 14. Dynamic Loudspeaker LS–166/U

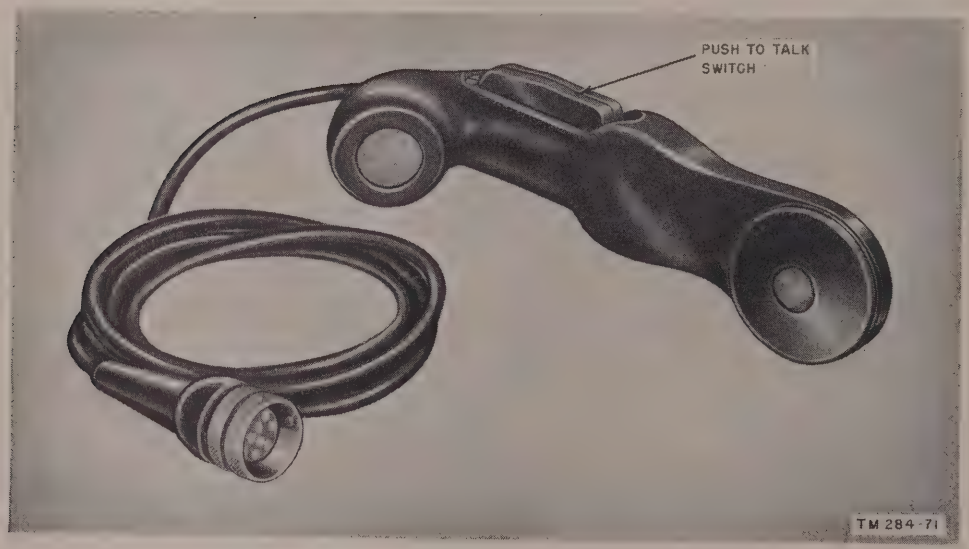


Figure 15. Handset H–33/PT.

Figure 16. Microphone M–29/U.

Figure 17. Headset Navy Type CW–49507 and Cord CX–1334/U.

SET CORD CX–1334/U. Headset Navy Type CW–49507 (fig. 17) consists of two series-connected 300-ohm receivers. A 14-inch cord is connected to the receivers and is terminated in Plug PL–54. The plug will mate with Jack JK–26, on one end of Headset Cord CX–1334/U. Headset Cord CX–1334/U is 5 feet long. It is terminated in a 10-pin audio connector and serves to connect the headset to the audio connectors on the receiver-transmitter, the interphone amplifier, and the control units.

Note. The audio accessories should not be used indiscriminately on any of the units, even though it is possible to connect them physically. Refer to chapter 3 for correct usage of the audio accessories.

h. SUBSTITUTE ACCESSORIES. The substitute audio accessories listed in the following table may be used only if it is absolutely necessary. Performance will be inefficient, however, because of

impedance mismatches, and operating facilities will be confined solely to Control Box C–375/VRC.

Standard item	Substitute item
Chest Set Group AN/GSA–6	Chest Set TD–4 on Cords CD–307–A and CD–318.
Headset-Microphone H–63/U	Headset H–16/U and Microphone T–45 or Headset HS–30 with Cord CD–933 and Microphone T–45.
Headset Navy Type CW–49507	Headset H–16/U or Headset HS–30 with Cord CD–933.
Cord CX–1334/U	Cord CD–307–A.
Microphone M–29/U	Microphone T–17.
Dynamic Loudspeaker LS–166/U	None.
Handset H–33/PT	None.

19. Running Spares

Running spares for normally expendable items, such as tubes, fuses, and vibrators, are supplied with some of the system components. The spares supplied are listed in the following subparagraphs:

Note. Case CY–684/GR, provided for carrying the spare parts, is not ample for carrying all of the parts supplied; therefore, it will be necessary to make a selection of those parts most likely to be needed. A suggested list of such parts is given in paragraph 38.

a. Spare Parts for Receiver-Transmitters RT–66/GRC, RT–67/GRC, and RT–68/GRC. The spare parts supplied for each of those components are identical:

2 tubes, electron, type 1A3.
2 tubes, electron, type 1AE4.
2 tubes, electron, type 1L4.
4 tubes, electron, type 1R5.
1 tube, electron, type 1S5.
6 tubes, electron, type 1U4.
3 tubes, electron, type 2E24.
1 tube, electron, type 3A4.
5 tubes, electron, type 3A5.
2 tubes, electron, type 3B4.
6 tubes, electron, type 3Q4.
2 tubes, electron, type 6AK5.

b. Spare Parts for AF Amplifier AM–65/GRC.

1 fuse, cartridge, 4-ampere (F–1).
1 fuse, cartridge, 10-ampere (F–1).
1 tube, ballast (R–52).
1 relay, thermal (K–1).
2 tubes, electron, type 6AK6.
3 tubes, electron, type 12AU7.
2 tubes, electron, type 0B2.

c. Spare Parts for Power Supplies PP–281/GRC and PP–282/GRC.

(1) *Power Supply PP–281/GRC.*

2 vibrators, plug-in type, 6-volt input.

(2) *Power Supply PP–282/GRC.*

2 vibrators, plug-in type, 24-volt input.

d. Spare Parts for Power Supplies PP–109/GR and PP–112/GR.

(1) *Power Supply PP–109/GR.*

2 fuses, cartridge, type AGU, 5-ampere.
2 fuses, cartridge, type AGU, 10-ampere.
1 relay, thermal (K–1 or K–2).
2 tubes, ballast (R–24, R–25, R–31 ,R–37, R–38, and R–40).
1 tube, electron, type 1007.
2 tubes, electron, type 0B2.
2 tubes, electron, type 0A2.
3 vibrators, 6-volt (E–1, E–2, and E–3).

(2) *Power Supply PP–112/GR.*

3 fuses, cartridge, type AGU, 5-ampere.
1 fuse, cartridge, type AGU, 3-ampere.
1 relay, thermal (K–1 or K–2).
3 tubes, ballast (R–24, R–25, R–31, R–37, R–38, and R–40).
1 tube, electron, type 1007.
2 tubes, electron, type OB2.
2 tubes, electron, type OA2.
3 vibrators, 24-volt (E–1, E–2, and E–3).

e. Spare Parts for Control Group AN/GRA–6.

4 lamps, glow, 125-volt, 1/25-watt GE lamp #WE–51.

f. Spare Mast Sections for Radio Sets AN/VRC–13, and –14.

1 Mast Section MS–116A.
1 Mast Section MS–117A.
1 Mast Section MS–118A.

g. Spare Mast Sections for Radio Set AN/VRC–15.

1 Mast Section MS–117A.
1 Mast Section AB–24/GR.

CHAPTER 2

INSTALLATION INSTRUCTIONS

Section I. INTRODUCTION

20. Scope of Instructions

The installation instructions included in this manual are generalized to make them applicable to any installation. The variety of vehicles in which the radio sets may be installed necessarily limits the specificity of such details as the exact location of units, the routing of cables, the placement of antennas, etc. Required clearances, interconnection data, and all other essential information is included. For specific details pertinent to particular vehicles, reference should be made to the installation instructions supplied with the installation units for the vehicles. Each of the installation units listed in paragraph 8 contains instructions pertinent to the particular vehicle for which the unit is intended.

21. General Unpacking Instructions

Take the usual precautions against damage to the equipment during the unpacking procedure. The following points of procedure should be observed whenever possible:

a. Unless instructions are given to the contrary, unpack equipment as required in the order described. Unpacking all boxes simultaneously may interfere with an orderly procedure, and will complicate any possible division of labor.

b. As each box is unpacked, check its contents against the master packing slip.

c. Use cutters to clip metal bands.

d. Do not pry off the tops or sides of boxes; use a nail puller to remove the nails and lift off the sides and/or the tops of boxes.

e. Save boxes, containers, and other packaging material, if practicable, for possible use for storage or reshipment.

Section II. VEHICULAR INSTALLATION DETAILS

Note. Vehicular installation procedures are those which involve modification of the vehicle (for example, the drilling of holes) or some special technique peculiar to a type of vehicle (for example, the routing of cables).

22. Unpacking

The material comprising the installation unit and the material contained in box 3 of the basic unit (par. 7) are required for the vehicular installation details. Unpack the installation unit and box 3 of the basic unit, observing the general precautions noted in paragraph 21.

23. Mounting MT–297/GR

Mounting MT–297/GR should be located and secured in place; all external connections should be completed.

a. Locate Mounting MT–297/GR according to the installation instructions for the particular vehicle. In an installation, allow the minimum clearances indicated in figure 18.

b. Loosen the four wingnut fasteners which hold the mounting table firm against the shock mounts. Swing the mounting table back on its hinges to make the junction box available. Remove the three cover plates from the junction box (fig. 19).

c. If the vehicular supply is 12 volts, connect jumpers between terminals 14 and 15 and between 15 and 16; also connect 17 and 18. For 24-volt operation these jumpers are not required.

d. Prepare one end of the 10-foot length of Special Purpose Cable WM–46/U in accordance with instructions given in figure 20.

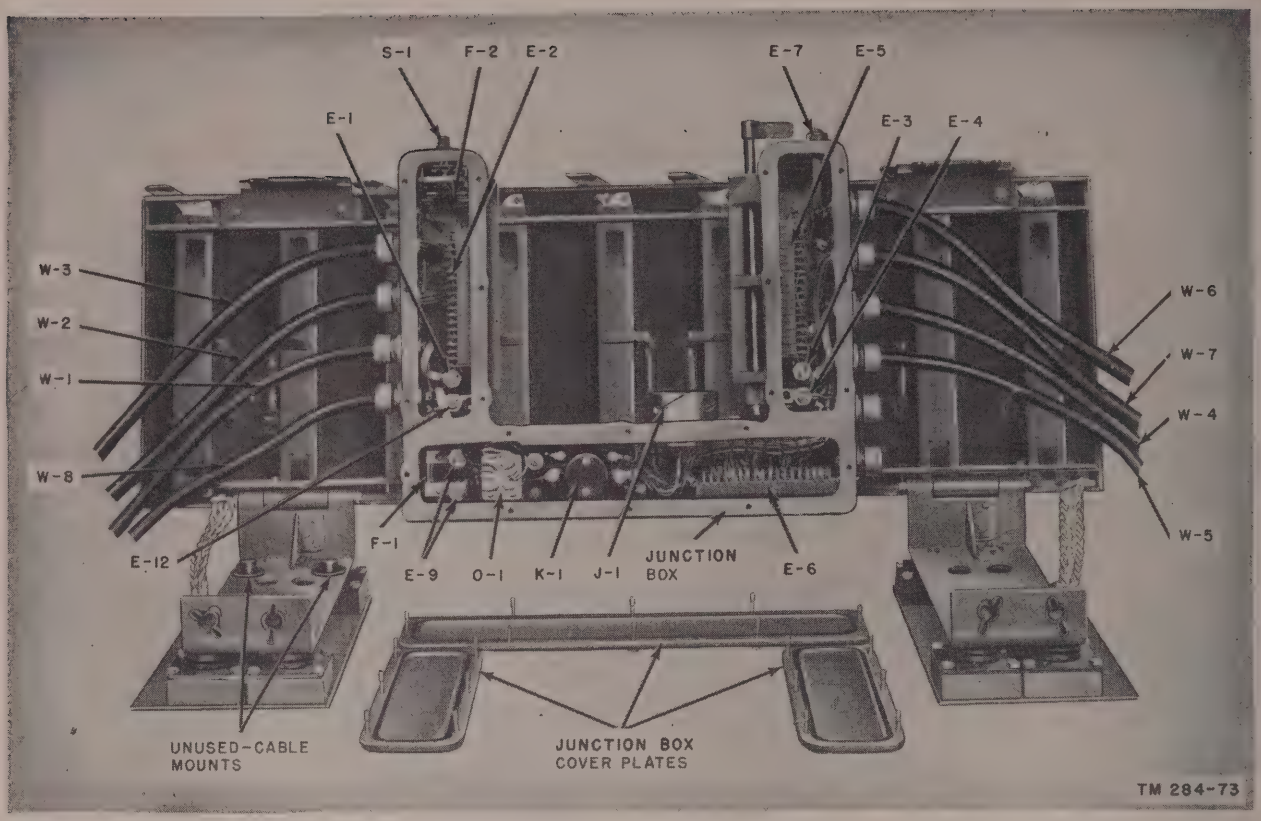


Figure 19. Mounting MT–297/GR, open view.

e. Loosen the bondnut on the cable clamp at one of the unused cable entries on the right-hand side of the junction box (fig. 19). Remove the nut, metal ring, and rubber washer from the cable clamp and slip them over the prepared end of the cable in the same order (nut, ring, and washer). (The rubber plug which will be found in the cable entry is for waterproofing an unused entry; it will not be required in the final assembly.)

f. Insert the prepared end of the cable through the cable entry and solder the individual conductors to the terminals of terminal board E–6 in the mounting (fig. 19); observe the color coding indicated in figure 21. The cable should be inserted until the outer insulation protrudes on the inside of the junction box. Sufficient slack should be allowed for all terminal connections.

g. When the connections are complete, tighten the bondnut on the cable clamp.

h. Before replacing the covers on the junction box, check the tightness of the solderless connectors, E–1, E–3, E–4, E–9, and E–12 (fig. 19). Cable compression can cause these connectors to become loose over a period of time. The fuse may be checked at this time also.

i. Replace the covers on the junction box.

j. In Radio Sets AN/VRC–13, –14, and –15, which do not use an auxiliary receiver, fasten the two receiver cables (W–1 and W–2 in fig. 19) to the unused cable mounts (fig. 19).

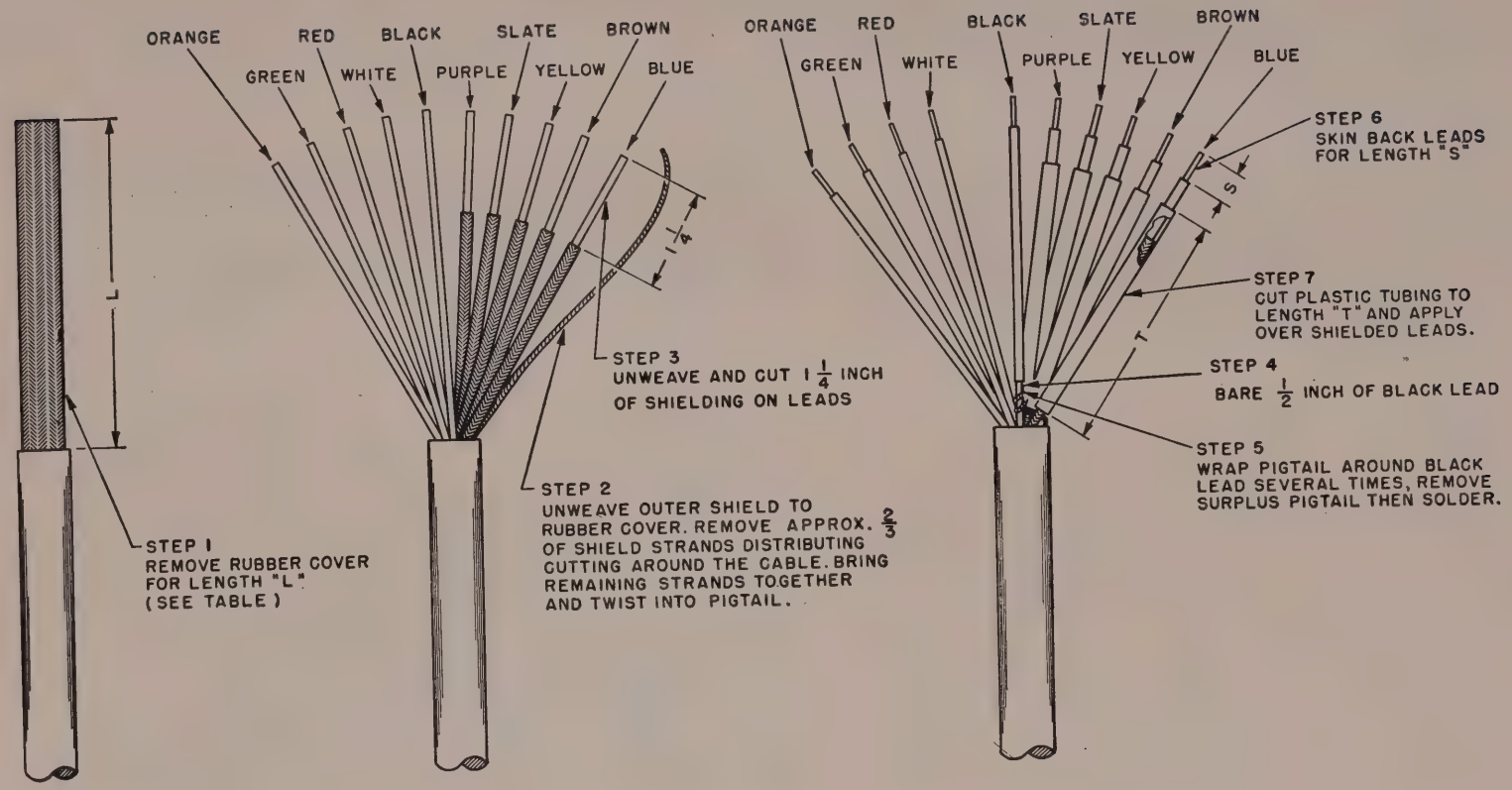
k. Spot and drill the eight mounting holes in accordance with the dimensional data shown in figure 18. Bolt the mounting to the vehicle.

l. Swing the mounting table back to its normal position and tighten the wingnut fasteners at each end of the table.

m. Route the loose end of Special Purpose Cable WM–46/U in accordance with instructions outlined in the installation instructions supplied with the vehicular installation unit. (Although the units to be interconnected are Mounting MT–297/GR and Control Box C–375/VRC, vehicular layout will determine whether a direct connection will be made or whether slip rings and/or junction boxes will intervene (par. 24*b*).

n. Place the power switch of the mounting in the OFF position. Do not turn this switch ON throughout the entire installation procedure.

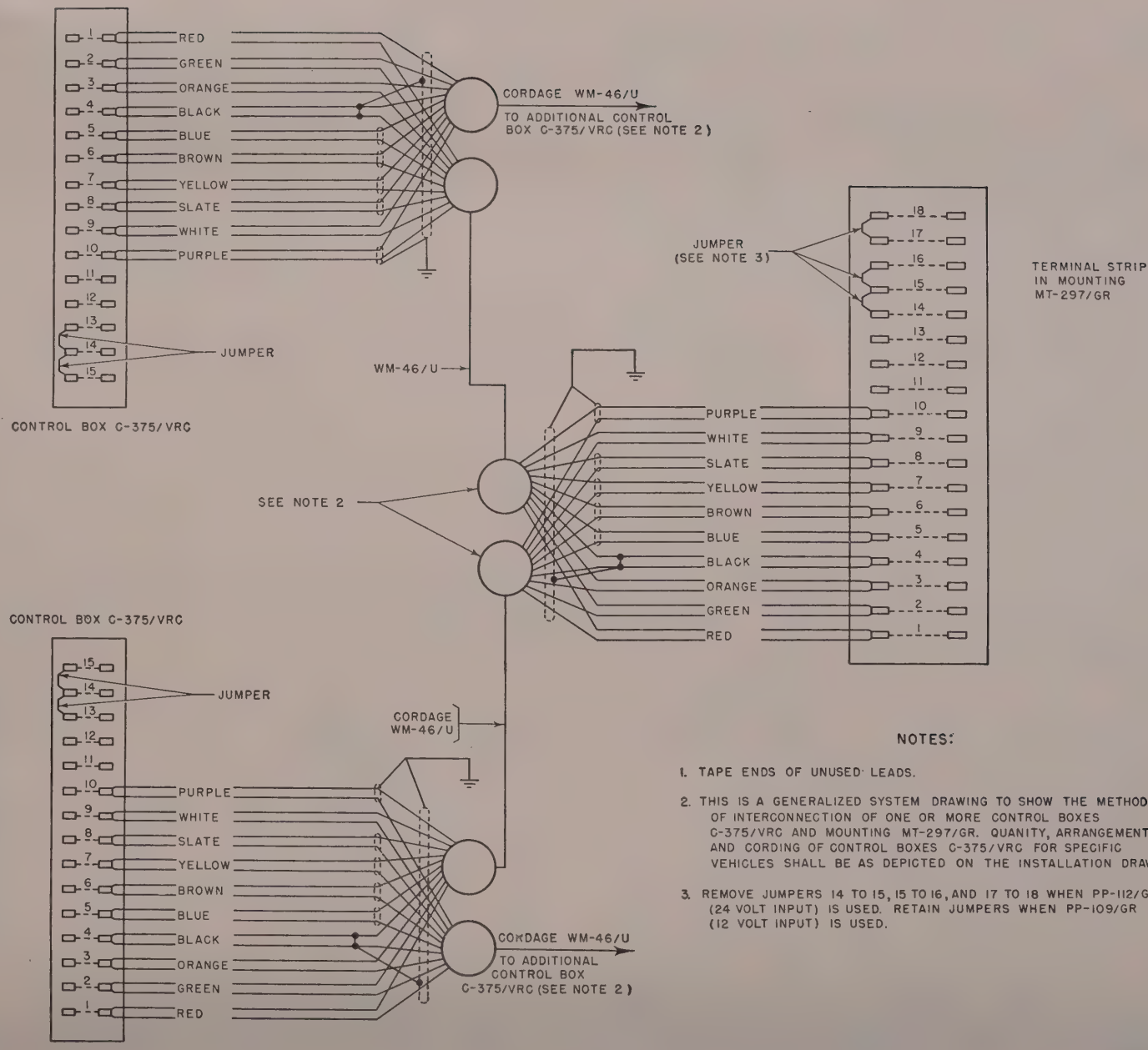
o. Connect the battery cable (W–8 in fig. 19) in accordance with instructions furnished with the



COMPONENT	LENGTH "L"	LENGTH "S"	LENGTH "T"
CONTROL BOX C-375/VRC	4	3/8	3 3/8
MOUNTINGS MT-297/GR, MT-298/GR, MT-299/GR, MT-300/GR	6	3/8	5 3/8
TERMINAL BOX SC-D-5319	6	3/8	5 3/8
TURRET TERMINAL BOX IN MEDIUM TANK M46	10	3/8	9 3/8
BENDIX - SCINTILLA CONNECTOR SIZE 28 SHELL	1 3/8	5/16	NOT USED
BENDIX - SCINTILLA CONNECTOR SIZE 22 SHELL	1 1/4	1/4	NOT USED

TM2643-8

Figure 20. Preparation of Special Purpose Cable WM-46/U.



NOTES:

1. TAPE ENDS OF UNUSED LEADS.
2. THIS IS A GENERALIZED SYSTEM DRAWING TO SHOW THE METHOD OF INTERCONNECTION OF ONE OR MORE CONTROL BOXES C-375/VRC AND MOUNTING MT-297/GR. QUANITY, ARRANGEMENT AND CORDING OF CONTROL BOXES C-375/VRC FOR SPECIFIC VEHICLES SHALL BE AS DEPICTED ON THE INSTALLATION DRAWING.
3. REMOVE JUMPERS 14 TO 15, 15 TO 16, AND 17 TO 18 WHEN PP-112/GR (24 VOLT INPUT) IS USED. RETAIN JUMPERS WHEN PP-109/GR (12 VOLT INPUT) IS USED.

Figure 21. Interconnection of Mounting MT-297/GR and Control Box C-375/VRC.

TM 284-51

installation unit. Generally, the cable will connect to a vehicular junction box rather than directly to the battery. Use the connector and bondnut supplied with the basic unit to secure the cable at its point of entry into the junction box. Leave enough slack to allow the mounting cable to be swung back without straining the cable.

24. Control Box C–375/VRC

One or more Control Boxes C–375/VRC may be supplied in the installation units in addition to the box supplied with the basic unit. The boxes must be located, mounted, and then interconnected with Mounting MT–297/GR.

a. Spot the location of the control boxes and drill the mounting holes. The exact locations will vary from vehicle to vehicle and must be determined from the specific instructions supplied with the installation unit. In all cases, minimum clearances of 2½, 4, and 3¾ inches should be allowed on the top, the bottom, and the sides, respectively. Before mounting the units, make the connections described for each unit (*b* and *c* below).

b. Remove the cover from the control box, remove the bondnut, ring, and washer from one of the cable clamps at the side of the box, and slip the nut, ring, and washer over the loose end of Special Purpose Cable WM–46/U. (This may be the other end of the cable connected to Mounting MT–297/GR; more commonly, it will be an extension of this cable from a vehicular junction box or another Control Box C–375/VRC. In all cases, the cable end should be prepared in accordance with instructions shown in 20.)

c. Solder the prepared conductors to the unused terminals of terminal board E–2 in the control box, observing the color coding shown in figure 21.

d. When connections are complete, tighten the cable clamp, replace the cover, and mount the units in place, using the hardware provided in the bag attached to each control box.

e. On the composition strips above the selector switch on the panel of each control box, write the following designations from left to right, respectively: "SET 1+INT" "SET 1+SET 2+INT" and "INT" only."

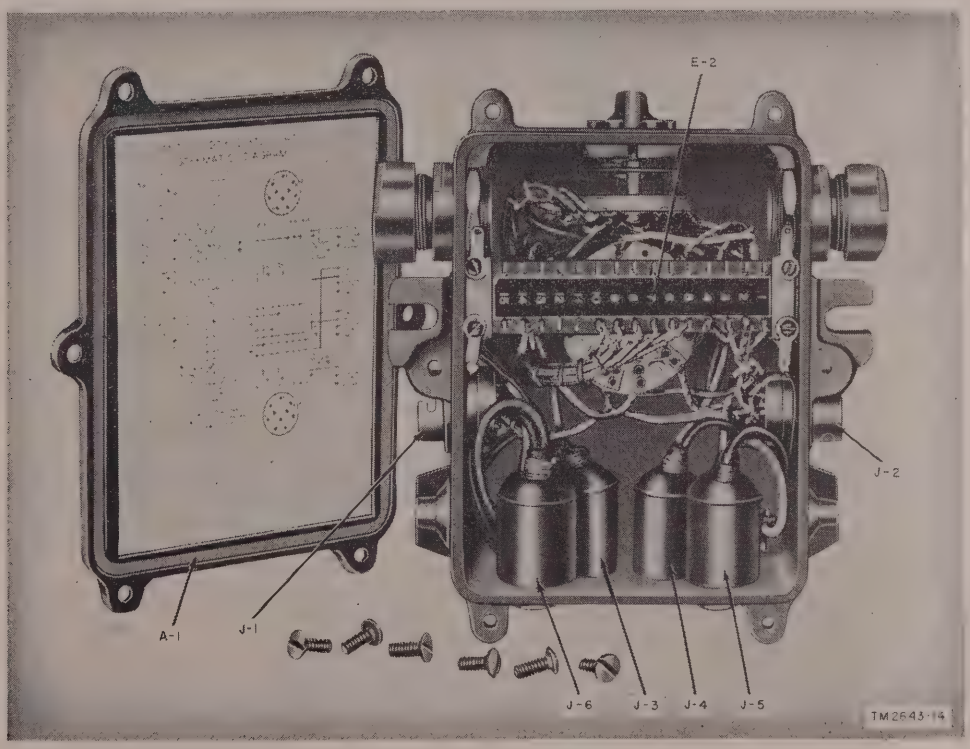


Figure 22. Control Box C–375/VRC, rear view.

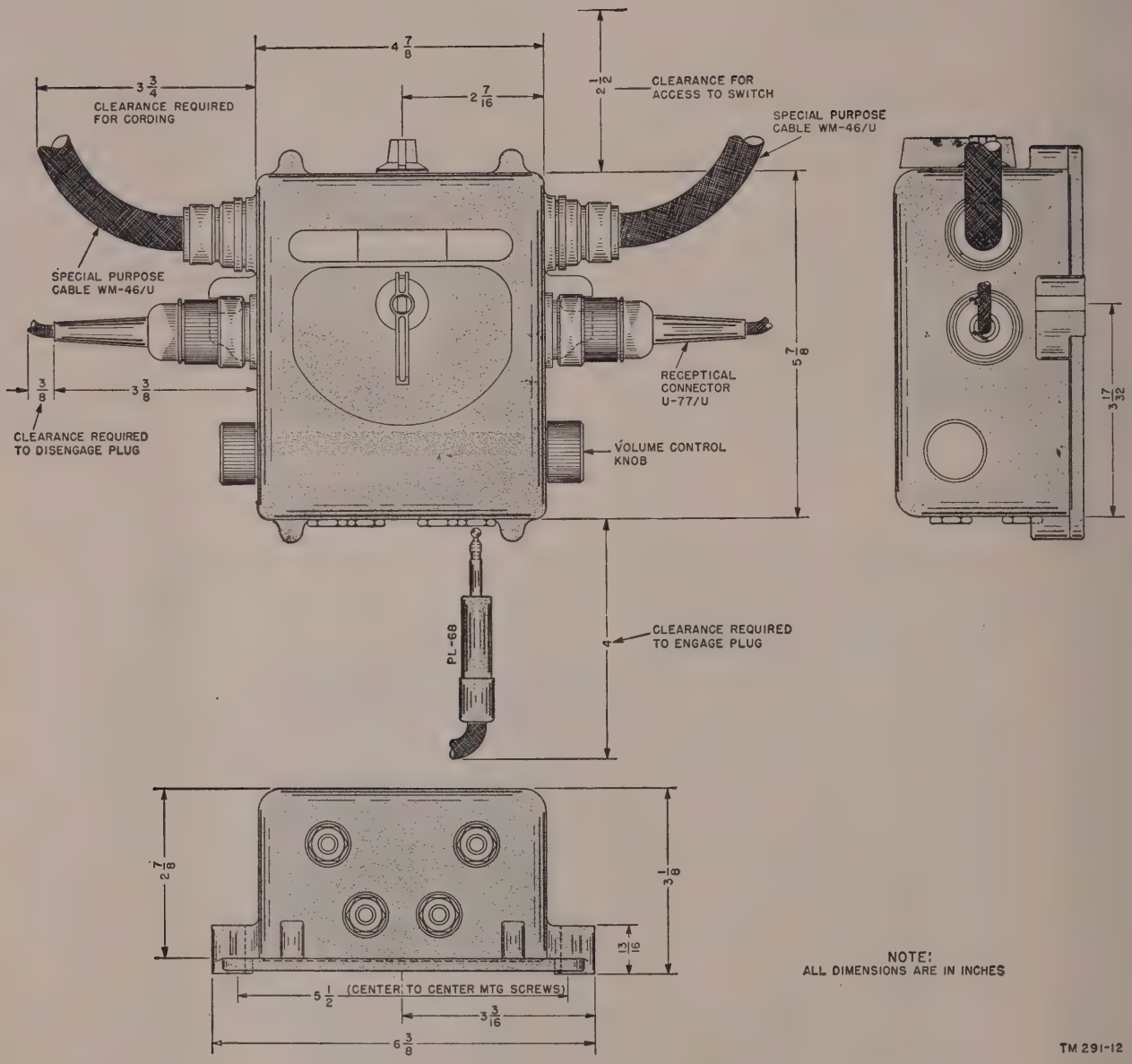


Figure 23. Control Box C-375/VRC, outline drawing.

25. Routing Antenna Cables

The antenna cable is used to connect from the receiver-transmitter panel to the antenna-mast bases. While actual connections cannot be made at this time, provisions must be made for routing the cables. RF Cable Assembly CG–568/U is provided for Set 1 with Radio Sets AN/VRC–13, while AN/VRC–14, and AN/VRC–15 utilize RF Cable Assembly CG–530/U.

a. If holes must be drilled in the vehicle, or any other vehicular modification must be made in order to route the antenna cables, follow the instructions supplied in the installation unit.

b. If the antenna cables are to be clamped to the vehicle, follow the instructions supplied in the installation unit. When a particular installation calls for the use of Adapter UG–306/U (supplied in the installation units), connect the adapter to the end of the cable which will connect to the mast base.

Note. In most cases, the 50-inch antenna cables supplied with the basic units will be sufficiently long. In those cases where a longer length is required, the cable and connectors will be supplied in the installation units. If the connectors are not already assembled to the cable, terminate the cables in accordance with instructions given in figures 24 and 25. Lengths must not be chosen at random. Use only the length specified in the installation instructions.

26. Vehicular Provisions for Antenna-mast Bases

a. Any drilling, installation of mounting brackets, and other vehicular details which are necessary for installing the antenna-mast base should be made at this time. The location of the mast and the mounting provisions are different for each type of vehicle, and necessary instructions will be supplied with the vehicular installation unit.

b. Because it is possible, in some instances, that the remaining installation procedures will not be completed until after the vehicle has been shipped to a different depot or organizational unit, actual mounting of the antenna-mast bases is not included as a vehicular installation detail. (Its installation might complicate the shipment of the vehicle.) Whether the entire installation is carried through to completion in one or two steps, however, the antenna-mast bases are the next items to be installed (par. 29).

27. Storing of Audio Accessories

The audio accessories supplied in the installation unit will not be required until the equipment is ready for an operational test (par. 36). The accessories should be unpacked and stored within the vehicle until they are needed.

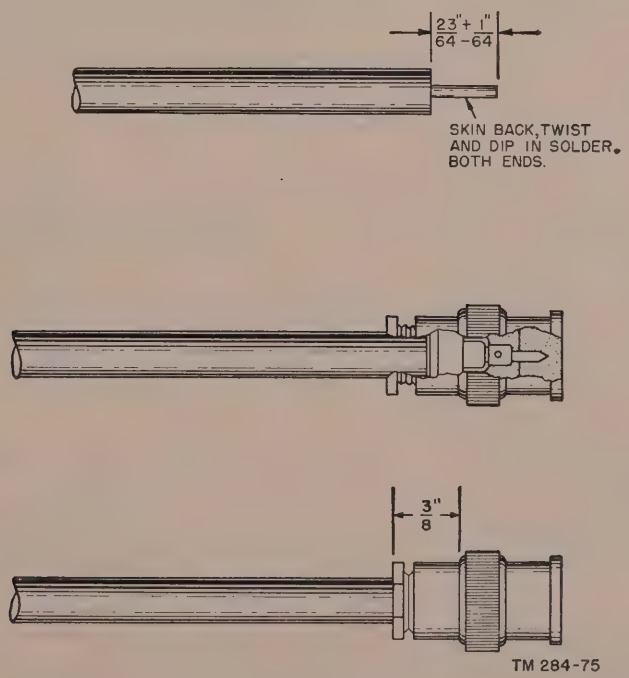
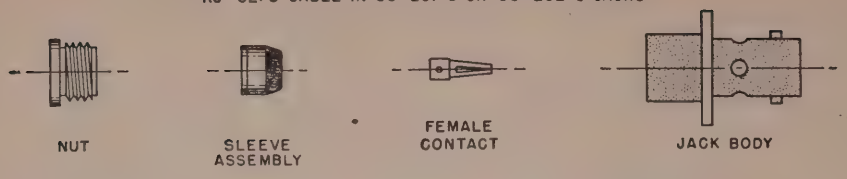
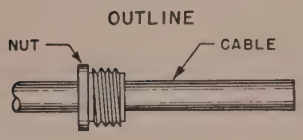


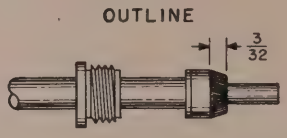
Figure 24. Termination of RF Cable Assembly CG–568/U.

RG-62/U CABLE IN UG-261/U OR UG-262/U JACKS

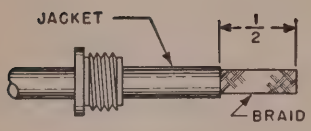




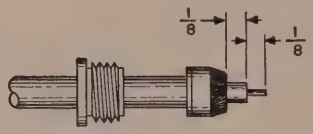
1. CUT OFF SHARP



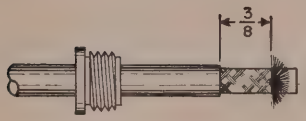
6. WITH SLEEVE IN PLACE, COMB OUT BRAID, FOLD BACK SMOOTH AS SHOWN, AND TRIM TO $\frac{3}{32}$ INCH FROM END.



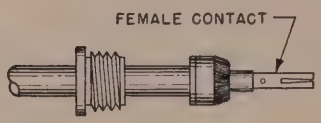
2. CUT OFF JACKET $\frac{1}{2}$ INCH FROM END, BEING CAREFUL NOT TO NICK BRAID.



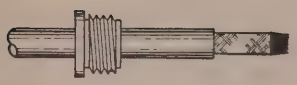
7. CUT INNER DIELECTRIC $\frac{1}{8}$ INCH FROM BRAID, BEING CAREFUL NOT TO NICK INNER CONDUCTOR AND CUT OFF INNER CONDUCTOR $\frac{1}{8}$ INCH FROM END OF DIELECTRIC.



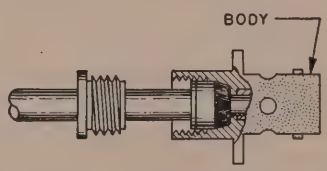
3. CUT OFF INNER INSULATION AND WIRE UNDER BRAID $\frac{3}{8}$ FROM END OF JACKET.



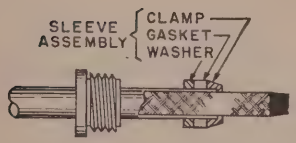
8. TIN INSIDE HOLE OF FEMALE CONTACT, TIN CENTER CONDUCTOR OF CABLE, SLIP FEMALE CONTACT IN PLACE AND SOLDER, REMOVE EXCESS SOLDER. BE SURE CABLE DIELECTRIC IS NOT HEATED EXCESSIVELY AND SWOLLEN SO AS TO PREVENT DIELECTRIC ENTERING BODY.



4. TAPER BRAID

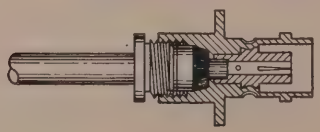


9. PUSH INTO BODY AS FAR AS IT WILL GO, THEN SLIDE NUT INTO BODY AND SCREW INTO PLACE, WITH WRENCH UNTIL MODERATELY TIGHT. HOLD CABLE AND SHELL RIGIDLY AND ROTATE NUT.



5. SLIDE SLEEVE OVER TAPERED BRAID TO FIT TIGHT AGAINST JACKET. BE SURE INNER SHOULDER OF SLEEVE FITS SQUARELY AGAINST END OF CABLE JACKET.

FINAL ASSEMBLY SHOWN IN SECTION



10. THE ASSEMBLY FOR PLUGS IS THE SAME EXCEPT FOR THE USE OF MALE CONTACTS AND A UG-260/U BODY.

TM284-76

Figure 25. Termination of RF Cable Assembly CG-530/U.

Note. The term *equipment installation* has been arbitrarily selected to refer to those installation procedures which are independent of the vehicle in which the radio sets are installed.

28. Unpacking

When all vehicular installation details have been completed, unpack the remaining boxes (1 and 2) of the basic unit (par. 7). Observe the general precautions noted in paragraph 21.

29. Mounting Mast Base AB–15/GR (fig. 26)

The location of the mast base is, in most cases, prescribed by the vehicle. In general, however, the mast base should be placed as high as possible and with a maximum cable length of 50 inches between the base and the receiver-transmitter. To install the mast base, follow the instructions outlined below and in figure 26.

a. Loosen the ground clamp on the adapter which is supplied on the mast base. Remove the adapter and replace it with Adapter UG–273/U. Retighten the ground clamp on the new adapter.

b. Separate the two cup insulators by unscrewing the body of the mast base.

c. Insert the body of the mast base, with upper cup insulator attached, through the hole in the mounting surface, which may be a special surface.

d. Bring the lower cup insulator up from the under side of the mounting surface so that the bolt in the lower insulator engages the body of the mast base. The lockwasher and the ground braid from the clamp on the adapter should be between the mounting surface and the lower insulator (fig. 26).

e. Screw the body of the mast base in a clockwise direction to tighten the assembly.

f. If the mounting surface does not provide a good ground, an additional ground bond must be made between the mounting surface and the vehicle.

30. Antenna Mast Section

(fig. 28)

a. Set 1 of Radio Sets AN/VRC–13 and –14 utilizes three long mast sections, Mast Sections MS–116–A, MS–117–A, and MS–118–A. Screw the three sections together and screw the assembly into the Set one mast base.

b. Set 1 of Radio Set AN/VRC–15 utilizes one long and one short mast section, Mast Sections MS–117–A and AB–24/GR, respectively. Screw the two sections together, and screw the assembly into the Set 1 mast base.

31. AF Amplifier AM–65/GRC

A power supply must be installed in the amplifier, and the fuse and internal power supply switch must be checked before the amplifier is

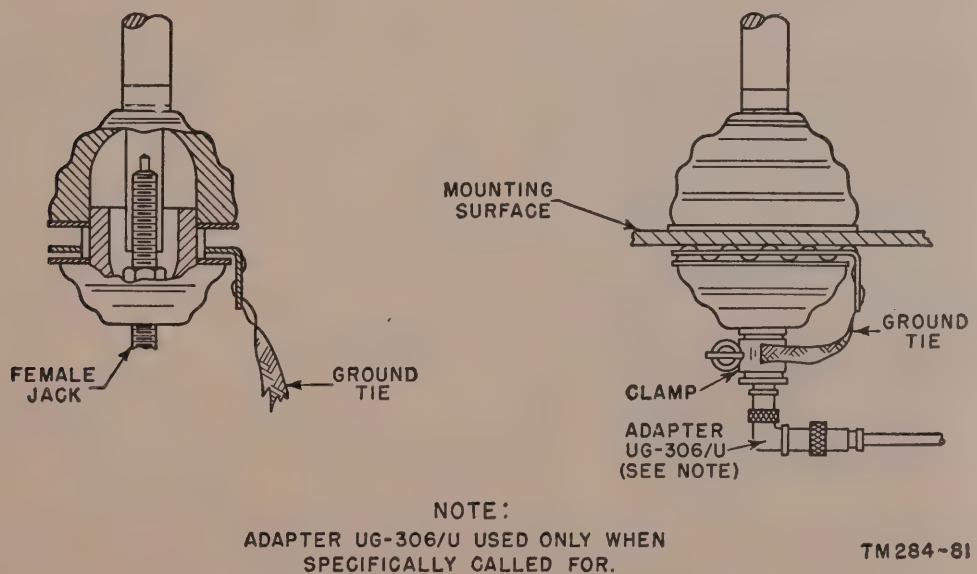


Figure 26. Mast Base AB–15/GR, installation drawing.

secured on the mountin. Perform the following steps:

a. Remove the panel-chassis assembly from the outer case (par. 89).

b. Insert and clamp the plug-in power supply unit (fig. 27) in the compartment on the amplifier chassis (fig. 47) so that the receptacle on the power supply mates with the plug within the amplifier compartment. Use Power Supply PP–281/GRC for 12-volt systems and Power Supply PP–282/GRC for 24-volt systems.

c. Turn the internal switch on the amplifier chassis (fig. 47) to the 12V or 24V position, depending on the supply voltage being used.

d. Check the fuse in the fuse holder on the front panel of the amplifier. The amplifier is shipped with a 4-ampere fuse which is suitable for operation in a 24-volt system with Power Supply PP–282/GRC. For 12-volt systems, with Power Supply PP–281/GRC, replace the 4-ampere fuse with a 10-ampere fuse from the running spares supplied with the unit (par. 19). Place a spare fuse of the proper amperage for the system in the clips on the chassis (fig. 47).

e. Fasten the correct supply voltage marker on the left-hand side of the amplifier panel. The amplifier is shipped with the *24V 4A* marker in place (fig. 6). For 12-volt systems, the marker should be replaced by the *12V 10A* marker which is *located beneath the 24V 4A marker.* The marker serves as a reminder that the plug-in power supply unit, the fuse, and the setting of the internal switch (*c* and *d* above) should correspond to the storage battery being used.

Figure 27. Power Supply PP–282/GRC, front view.

f. Replace the panel-chassis assembly in the case and turn the OFF–INT–RT–70 switch to the OFF position.

Caution. Before placing the amplifier or any of the units on the mounting, again check the position of the power switch on the mounting. Turn it to the OFF position.

g. Release the locking mechanism for the two right-hand channels of the mounting by rotating the locking handles (fig. 7) toward the left.

h. Place the amplifier on the mounting so that the rails on the bottom of the case rest in the two right-hand channels of the mounting. Rotate the locking handles to the right to secure the amplifier in place.

32. Set 1 and Set 1 Power Supply

a. Place the OPERATE switch of the Set 1 Power Supply PP–109/GR or PP–112/GR in the OFF position, and secure the unit on the mounting beside AF Amplifier AM–65/GRC (fig. 28). Use Power Supply PP–109/GR in 12-volt systems and Power Supply PP–112/GR in 24-volt systems.

b. Place and lock the Set 1 receiver-transmitter on the mounting next to the power supply. Refer to figure 28 for the particular receiver-transmitter used in each system.

33. Interconnections

Make the system interconnections outlined below and illustrated in figure 28.

a. Connect Adapter UG–306/U to the ANT connector on Set 1. Connect one end of the antenna cable (RF cable Assembly CG–568/U or CG–530/U) as indicated in figure 28 to the adapter; connect the other end of the cable to the Set 1 mast base (par. 29). Another UG–306 may be used at the base depending upon the installation kit and instructions supplied.

b. Check that the OPERATE switch of the Set 1 power supply is in the OFF position, and connect Special Purpose Cable Assembly CX–1211/U between the POWER OUT receptacle of the power supply and the POWER IN receptacle of Set 1. Tighten the screw handles on the cable assembly connectors as much as possible to insure waterproofing.

RADIO SET	RECEIVER-TRANSMITTER	MAST SECTION	ANTENNA CABLE	POWER SUPPLIES
AN/VRC-13	RT-66/GRC	MS-116-A MS-117-A	CG-568/U	PP-109/GR WHEN USED WITH 12-V SOURCE OR PP-112/GR WHEN USED WITH 24-V SOURCE
AN/VRC-14	RT-67/GRC	MS-118-A	CG-530/U	
AN/VRC-15	RT-68/GRC	MS-117-A AB-24/GR		

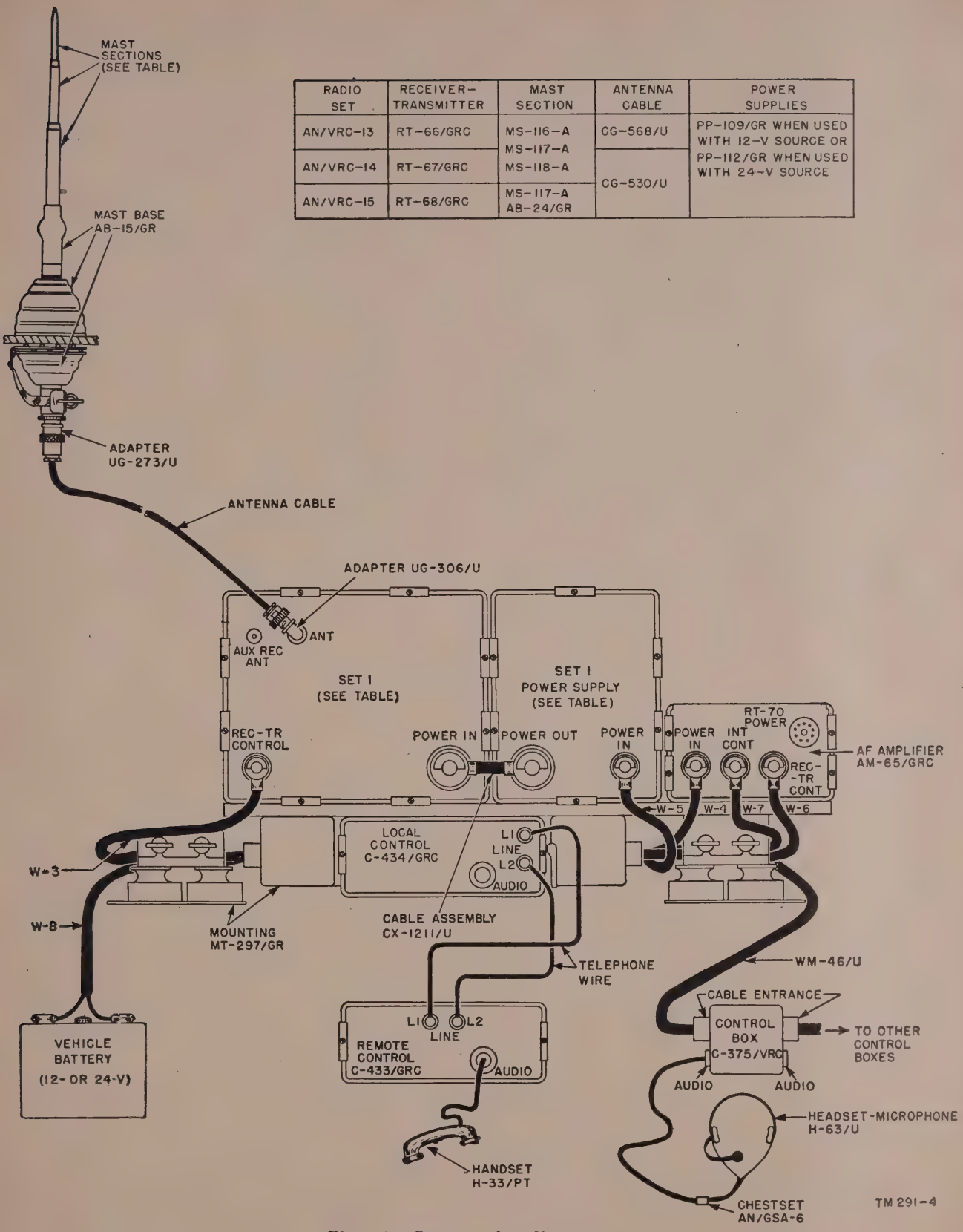


Figure 28. System cordage diagram.

c. Connect cable W–6 from the mounting (fig. 19) to the REC-TR CONT receptacle on the amplifier. Tighten the screw handle on the cable connector as much as possible to insure waterproofing.

d. Connect cable W–7 from the mounting to the INT CONT receptacle on the amplifier. Tighten the screw handle on the cable connector as much as possible to insure waterproofing.

e. Connect cable W–4 from the mounting to the POWER IN receptacle on the amplifier. Tighten the screw handle on the cable connector as much as possible to insure waterproofing.

f. Connect cable W–5 from the mounting to the POWER IN receptacle on the Set 1 power supply. Tighten the screw handle on the cable connector as much as possible to insure waterproofing.

g. Connect cable W–3 from the mounting to the REC-TR CONTROL receptacle on Set 1. Tighten the screw handle on the cable connector as much as possible to insure waterproofing.

34. Audio Accessories

a. Assembly. The chest sets, headset, and headset-microphone sets provided in the installation unit should be assembled and made ready for use. The remaining audio accessories are shipped assembled.

b. Disposition. The specific disposition and usage of audio accessories depend, in part, upon vehicular conditions and modes of operation to be used. Probable dispositions are indicated below. (See ch. 3 for the operating modes possible at the various audio connectors.)

(1) Chest Set Group AN/GSA–6 will be used with Headset-Microphone H–63/U at the audio connectors of Control Box C–375/VRC and Local Control C–434/GRC.

(2) Dynamic Loudspeaker LS–166/U, when supplied, will generally be used at the audio connector on Control Box C–375.

(3) Microphone M–29/U is generally used at Control Box C–375.

(4) Headset Navy Type CW–49507 with Cord CX–1334/U will generally be used at Control Box C–375.

(5) Handset H–33/PT will be used generally at either Remote Control C–433/GRC or Local Control C–434/GRC.

Section IV. ADJUSTMENTS FOR OPERATION

Note. Personnel who are to perform the procedures described in this section should be familiar with the use of controls and instruments and with the operating procedures described in chapter 3.

35. Set 1 Antenna Tuning

Receiving and transmitting antenna circuits must be tuned separately in the Set 1 receiver-transmitters. Once the antenna circuits are tuned for a particular system antenna, it is not necessary to retune during normal operation.

a. Receiver Tuning. Perform steps 1 through 16, and 18 through 21 of the equipment performance checklist (par. 81) to determine that the receiver is operating. Leave the receiver operating and adjust as follows:

(1) Tune for a signal in the top 900 kc of the tuning range (par. 57). If a signal is not heard, utilize the signal from another set or loosely couple the output of a signal generator to the receiver. The signal must be weak so as not to overload the receiver.

(2) Using an ordinary screw driver, adjust the REC-ANT TUNE control on the Set 1 panel for a maximum signal in the headset. Reduce the r-f input signal strength as the audio output level increases. Repeat the adjustment.

b. Transmitter Tuning. Perform steps 1 through 16 and 24 through 27 of the equipment performance checklist (par. 81) to determine that the transmitter is operating. To tune the transmitter antenna, proceed as follows:

(1) Tune the receiver-transmitter (par. 57) to the extreme low end of its tuning range (MCS control at lowest mc calibration, TENTH MCS control at zero). Leave the TENTH MCS control at zero throughout the tuning procedure.

Caution. Do not turn the TENTH MCS control while the TR-ANT TUNE control is being adjusted. Serious damage to the tuning mechanism can result.

(2) Turn the TRANS-ANT COUPLING control completely counterlockwise to obtain minimum coupling.

(3) Press and hold the RADIO and press-to-talk switches on the chest set.

Note. Keep all personnel removed as far as possible from the antenna while making the following adjustments.

(4) Using an ordinary screw driver, adjust the TR-ANT TUNE control on the Set 1 panel for a maximum r-f reading on the panel meter. If it is impossible to obtain a reading, advance the setting of the TRANS-ANT COUPLING control slightly and repeat the procedure. Keep the coupling as low as possible while adjusting the TR-ANT TUNE for a maximum r-f reading. When the maximum reading is obtained, release the RADIO or push-to-talk switch on the chest set.

(5) Repeat (3) and (4) above for each integral mc calibration on the MCS dial and for the highest detented frequency of each receiver-transmitter (27.9, 38.9, and 54.9 mc for Receiver-Transmitters RT–66/GRC, RT–67/GRC, and RT–68/GRC, respectively).

(6) When adjustments are complete for each setting of the MCS control, turn the MCS control to the approximate center of the tuning range, and adjust the TRANS-ANT COUPLING control for a maximum r-f reading.

(7) Repeat (3) through (6) above.

36. Operational Check

When Set 1 has been tuned, make a complete operation check of the system by performing the procedure outlined in the equipment performance checklist (par. 81). Omit steps 31 to 44 which pertain to Control Group AN/GRA–6. If abnormal indications are obtained, it will be necessary to trouble-shoot the system. When required, follow the trouble-shooting suggestions contained in the checklist.

Section V. CONTROL GROUP AN/GRA–6 AND MISCELLANEOUS EQUIPMENT

37. Control Group AN/GRA–6

Control Group AN/GRA–6 should only be installed when its peculiar facilities are required (par. 42). An initial installation should be made, however, to determine that the equipment will operate properly. Make this initial installation in accordance with the following instructions after the rest of the system has been completely installed, tuned, and checked. Turn the power switch on the mounting of OFF before beginning the installation.

a. Local Control C–434/GRC. Prepare and install the local unit as follows:

(1) Lossen the screw fasteners on the panel and remove the panel-chassis assembly from the case.

(2) Insert two 1½-volt Batteries BA–30 into the battery compartment and place the chassis-mounted switch (S–1) in the BELL position. Replace the panel-chassis assembly in the case (fig. 29).

(3) Remove the protective cover plate from the plug at the rear. Open the hinged door to the right of the plug and store the cover in the clamp provided on the door (fig. 30).

(4) Insert the unit in Mounting MT–297/GR. Be sure the unit fits properly into the receptacle provided in the mounting. The locking lever to the right of the mounting bay which accommodates the unit (figs. 1 and 7) must be held in the open position (up) until the unit is properly installed and then rotated clockwise to the locking position (down).

b. Remote Control C–433/GRC. Preparation and installation of the remote unit is as follows:

(1) Loosen the fasteners which secure the case. Remove the panel-chassis assembly from the case.

(2) Insert two 1½-volt Batteries BA–30 in the compartment provided, and insert and connect a 45-volt Battery BA–414/U in its compartment. Place the chassis-mounted switch in the BELL position and replace the panel-chassis assembly in its case (figs. 31 and 33).

c. Interconnection. When the above steps have been taken, the units are interconnected as follows:

(1) Interconnect the local and remote units with telephone wire over as great a distance (up to 2 miles) as desired. Insert no switchboards or drops on the line.

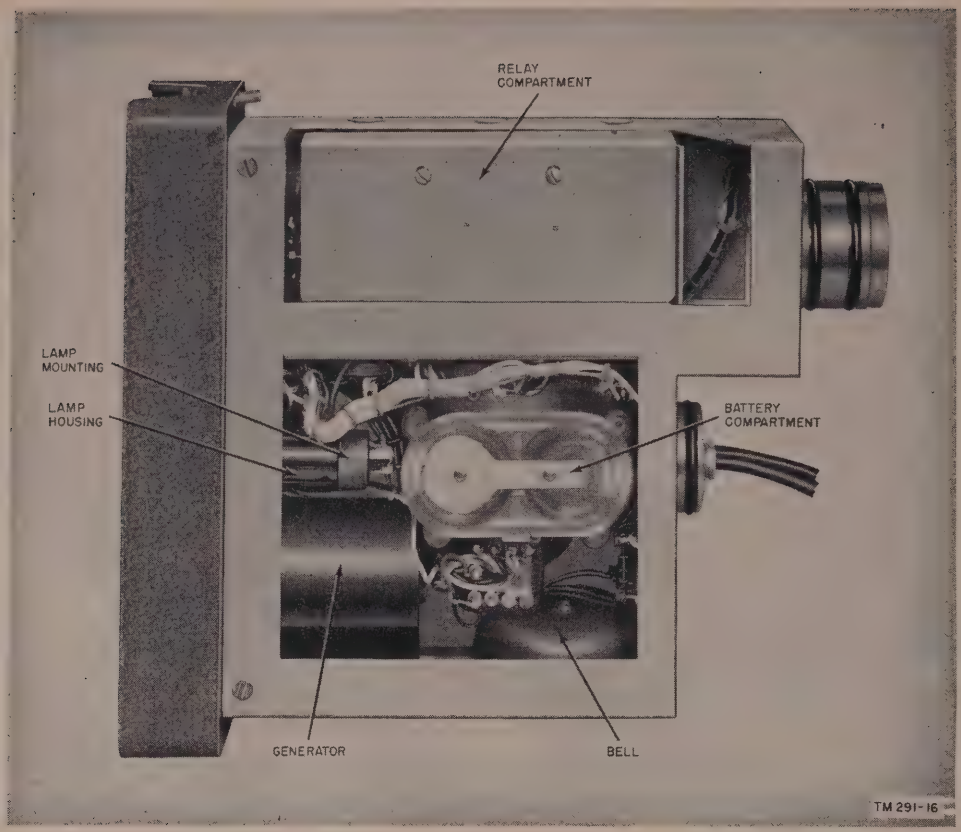


Figure 29. Local Control C–434/GRC, batteries installed.

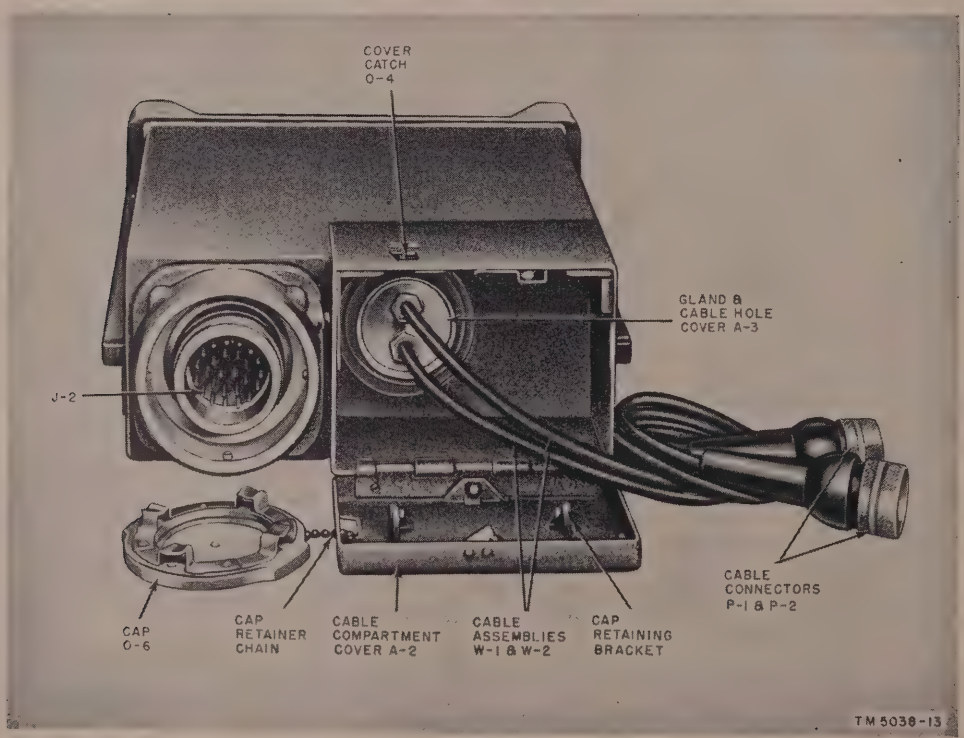


Figure 30. Local Control C–434/GRC, rear view.

Figure 31. Remote Control C–433/GRC, batteries installed.

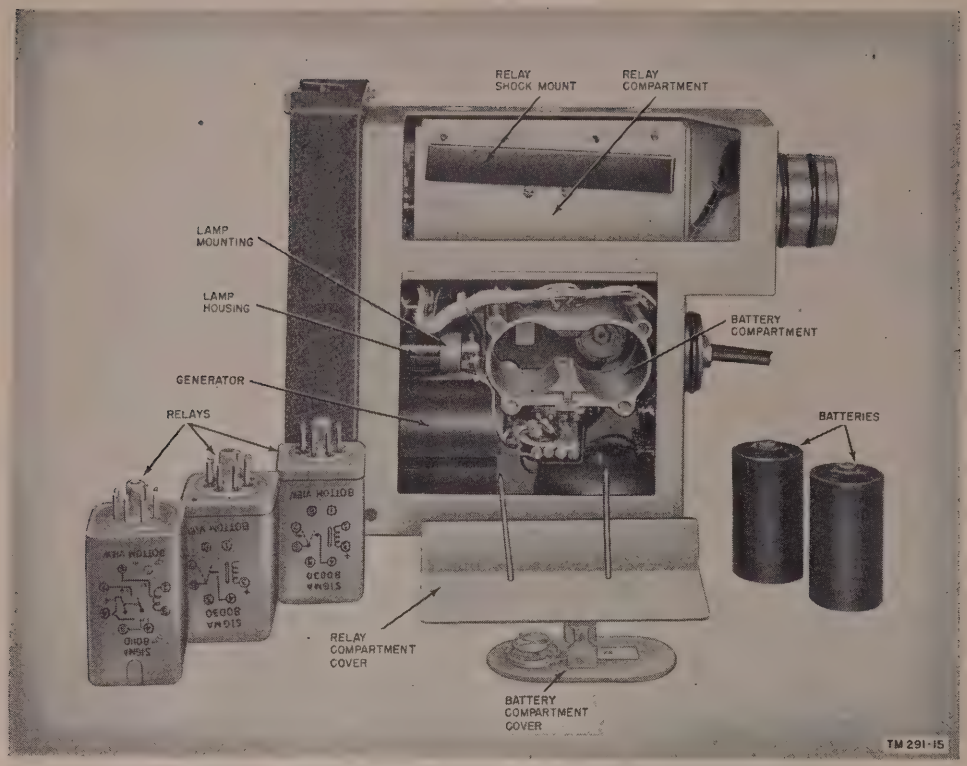


Figure 32. Local Control C–434/GRC, batteries removed.

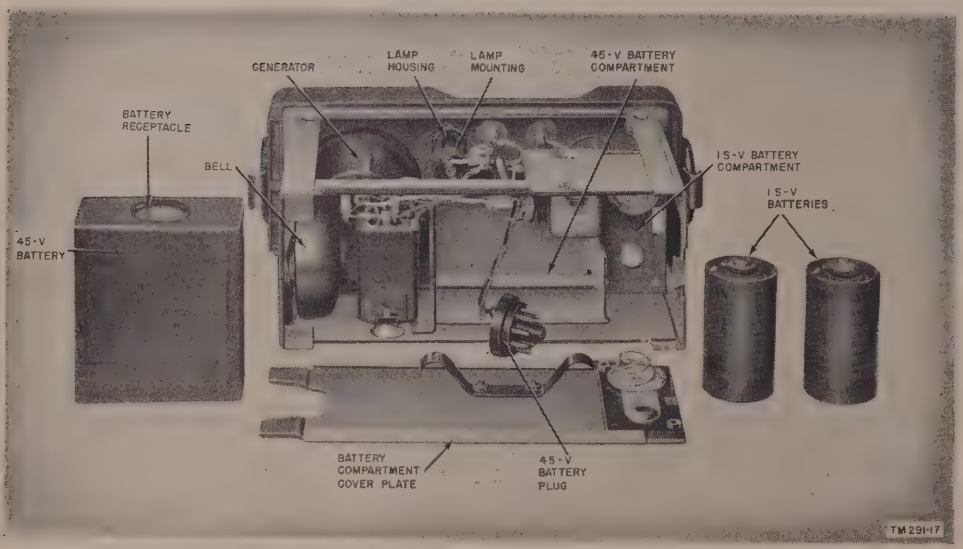


Figure 33. Remote Control C–433/GRC, batteries removed.

(2) Strip the insulation off the wires approximately ¾ inch from the ends, and tin the bared wires before clamping them in the binding posts (designated LINE L1 and L2) on each of the units.

d. Testing and Securing. On completion of the above steps, continue as follows:

(1) Perform the preliminary starting procedure (par. 54) and steps 31 through 45 of the equipment performance checklist (par. 81).

(2) When satisfactory performance has been obtained, turn the power switch on the mounting to OFF and remove the local control unit from the mounting.

(3) Replace the protective cover on the plug at the rear of the local control unit and connect the unit to Set 1 by means of the cable and plug in the compartment at the rear of the unit. Audio connector P–1 (fig. 30) connects to the AUDIO connector on Set 1.

(4) Return the power switch on the mounting to ON and perform step 38 of the equipment performance checklist (par. 81).

(5) After operation has been checked, disconnect the local control unit and remove the batteries from both the local and remote units. Never leave the batteries installed unless the units will be used in a relatively short period of time.

38. Storage of Equipment Not in Use

Equipment not immediately required for operation, such as running spares, audio accessories, or Control Group AN/GRA–6, should be packed in the containers provided and stored in a convenient location within the vehicle.

a. Running Spares. All spare mast sections should be placed in Bag CW–206/GR in the pockets. Case CY–684/GR should be filled with spare parts from the stock of running spares supplied with each unit, and it too should be stored in Bag CW–206/GR. Since Case CY–684/GR will not hold all the spare parts provided, a judicious selection should be made from the spares available. It is suggested that the following list be used as a guide in selecting the spares for packaging in Case CY–684/GR.

Spare part	Quantity
Vibrator (6- or 24-volt for 12- and 24-volt systems, respectively).	1
Relay, Ratheon CK–118	1
Ballast tube, 800 ma (milliamperes)	1
Ballast tube, 600 ma	1
Tube type 0A2	1
Tube type 0B2	1
Tube type 2E24	1
Tube type 6AK6	1
Tube type 6AK5	2
Tube type 3A5	2
Tube type 3Q4	2
Tube type 3A4	1
Tube type 3B4	1
Tube type 1Z4	2
Tube type 1S5	1
Tube type 1A3	2
Tube type 1U4	3
Tube type 1R5	3
Tube type 1AE4	1
Tube type 12AU7	1
Tube type CK–1007	1
Lamp NE–51	1
Lamp, Mazda 331	2
Fuse (10- or 4-ampere for 12- and 24-volt systems, respectively).	3

b. Audio Accessories and Technical Manuals. Audio accessories not required for operation can be stored in Bag CW–206/GR. Technical manuals can also be stored in the same bag.

c. Control Group AN/GRA–6. When Control Group AN/GRA–6 is not required for operation, it should be stored in Bag CW–189/GR.

CHAPTER 3

OPERATING INSTRUCTIONS

Section I. MODES OF OPERATION

39. Monitoring

Listening to received signals with no attempt to communicate with the sending station constitutes monitoring. The receiver section of the receiver-transmitter in the radio set can be operated strictly as a monitor if so desired. The receiver can be monitored at the interphone box, local or remote control units, and also it is possible to monitor it by means of a speaker or headset directly connected to the unit audio connector.

40. Push-to-Talk Operation

a. Push-to-talk operation utilizes one-way reversible communication facilities. Receiving facilities are available provided that power is supplied to the equipment, but transmission requires closure of one or more switches (generally the push-to-talk switch of a chest set, handset, or microphone). Communication is possible in only one direction at a time and it is impossible for the receiving part to *break-in* on the sending party.

b. Push-to-talk operation of Set 1 may be selected at the interphone box, the local control unit, and the remote control unit (pars. 58 and 59, respectively). A chestset at the interphone box is most commonly used. It is also possible to operate the receiver-transmitter individually by means of a chest set or handset connected directly to the unit audio connector.

41. Interphone Facilities

Interphone facilities are available to the operators at each interphone box and at the panel of the interphone amplifier. Normally, the panel of the interphone amplifier will not be used as an interphone station, but it is a convenient point for checking the operation of the amplifier (par. 85).

42. Remote Control Facilities

The use of Control Group AN/GRA–6 makes it possible to control application of power for the radio sets and/or push-to-talk operation of Set 1 from a control station 2 miles removed from the major installation. Refer to paragraph 59 for operating details.

43. Duplex Telephone Facilities

When Control Group AN/GRA–6 is used for remote control of the radio sets, duplex telephone facilities are available for communication between local and remote control units whether or not the local control unit is plugged into the mounting.

Section II. CONTROLS AND INSTRUMENTS

44. Introduction

The following paragraphs (45 through 51) indicate the functions of operational controls and instruments on the panels of the various units. Although ordinary operating procedures are confined mainly to control units and audio accessories, and understanding of the controls and instruments on the individual units is essential to efficient operation and maintenance of the radio sets.

45. Mounting

The main power switch for the radio sets and a clear pilot lamp are mounted on the junction-box portion of Mounting MT–297/GR (fig. 7).

Control or instrument	Function
OFF-REMOTE-ON switch (S-1).	Controls battery power to the radio sets. OFF: Opens battery circuit in the mounting. REMOTE: Places power control in hands of operator at Remote Control C-433/GRC. ON: Connects battery power to the input terminals of the interphone amplifier and Set 1 power supply.
POWER lamp (E-7)	Indicates (when lit) that power has been made available at the input terminals of the interphone amplifier and Set 1 power supply. Dimmer control provides for masking the glow of the lamp.

46. Interphone Amplifier

The controls of the interphone amplifier are shown in figure 34 and their functions are listed in the following chart.

Control	Function
OFF-INT-RT-70 switch*	Controls power for the interphone amplifier or for the Set 2 receiver-transmitter and the interphone amplifier. OFF: Breaks battery circuit at input terminals of the amplifier. INT: Completes power circuits for interphone amplifier. RT-70: Completes power circuits for interphone amplifier and Set 2 receiver-transmitter (Not used).*
VOLUME control (R-26)	Controls output level from Set 1+Set 2+Interphone channel to C-434 and panel-mounted AUDIO connector.
AUDIO connector (J-1)	Provides means for connecting a chest set (with microphone-headset) for monitoring and interphone operation over the Set 1+Set 2+Interphone channel. *Note.* If chest set is used in this manner, both the RADIO and push-to-talk switches must be depressed for interphone operation.

*Do not turn the OFF-INT-RT-70 switch to the RT-70 position unless a Receiver-Transmitter RT-70/GRC, or its equivalent load is used across the output terminals which supply the receiver-transmitter.

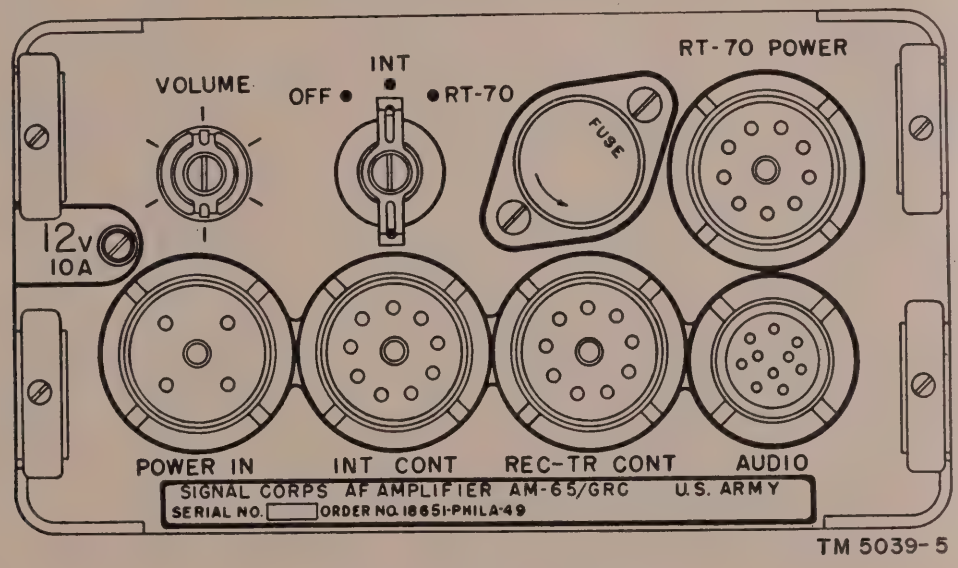


Figure 34. Interphone amplifier panel.

47. Set 1 Power Supply

The controls for both the 12-volt and 24-volt Set 1 power supply (Power Supplies PP-109/GR and PP-112/GR, respectively) are the same. Figure 35 illustrates the panel layout of controls. The following chart lists the control functions.

Control	Function
OPERATE switch (S-1)	Controls power to Set 1 receiver-transmitter power supply. OFF: Opens battery circuit at input terminals of the power supply.
OPERATE switch (S-1)—Continued	RECEIVE: Completes battery circuit to receiver-power supply circuits and to receiver-transmitter relay-supply circuit. TRANS & RECEIVE: Completes battery circuit to transmitter power-supply circuits, in addition to those circuits listed under the RECEIVE position.
TRANS POWER switch (S-2).	Provides for HIGH or LOW r-f power operation of the transmitter in the HIGH and LOW positions, respectively.

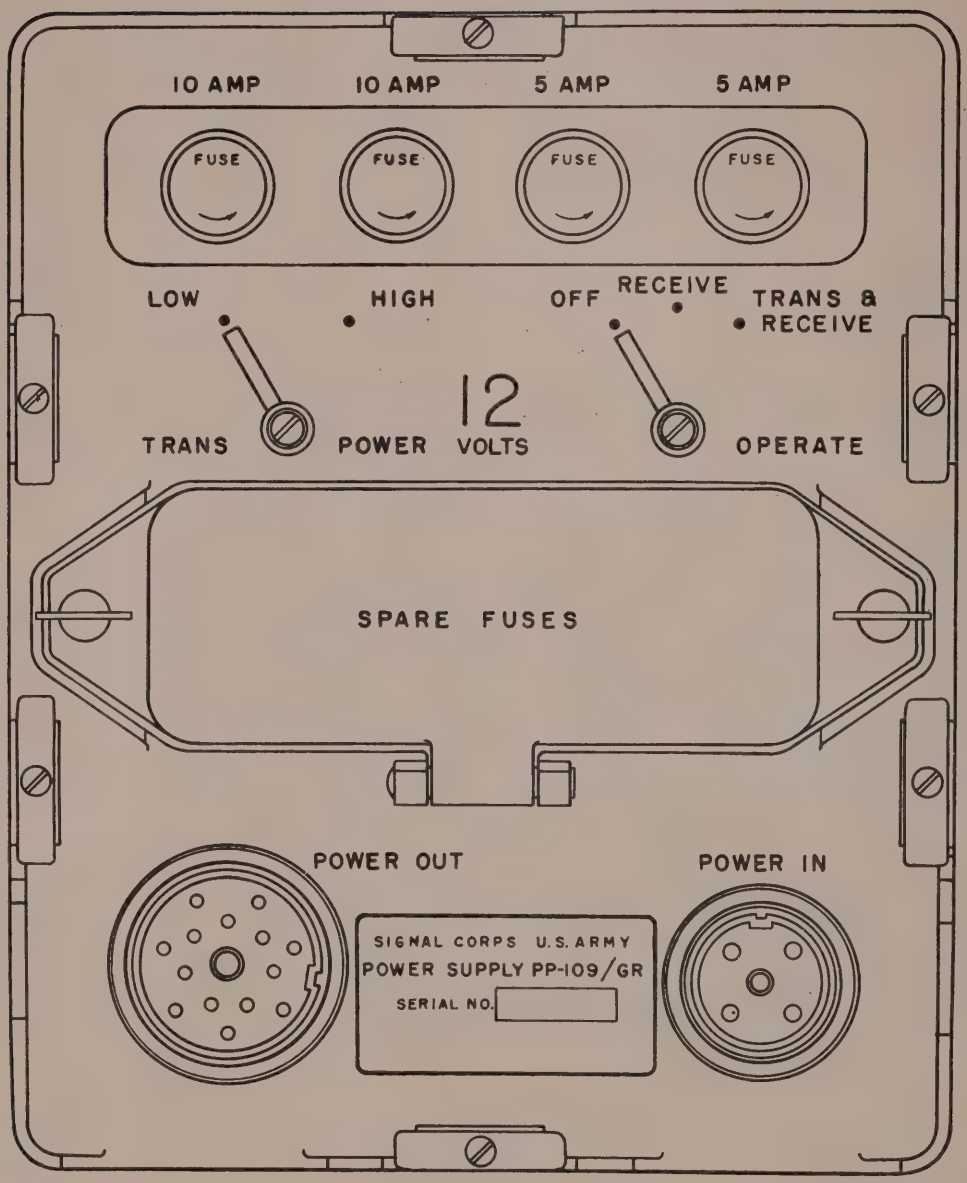


Figure 35. Set 1 power supply panel.

48. Set 1 Receiver-Transmitter

The controls for the Set 1 receiver-transmitter (Receiver-Transmitter RT–66/GRC, RT–67/GRC, or RT–68/GRC) are illustrated in figure 36. The functions are listed in the following chart.

Control or instrument	Function
Dial LAMP (E–313)	Illuminates tuning dials except when RING DIAL LIGHT (OFF-ON) switch is OFF.
RING-DIAL LIGHT (OFF-ON) switch (S–302).	Controls dial LAMP, microphone, and ringing oscillator circuits. OFF: Completes microphone circuit and turns dial LAMP off. ON: Completes microphone circuit and turns dial LAMP on. RING: Spring return; breaks microphone circuit, turns on ringing oscillator, turns on dial LAMP, and turns on transmitter.
VOLUME control (R–303)	Adjusts the audio output level to speaker and phone terminals of the panel-mounted AUDIO connectors.
SQUELCH-OFF control (R–302 and S–303).	Controls the noise suppression circuits of the receiver and determines what minimum level of input signal will be required for operation of the receiver. In OFF position, provides no noise suppression and allows receiver to operate at maximum sensitivity.
MCS and TENTH MCS tuning controls and dials.	Selects and indicates the operating frequency. MCS: Selects and indicates each integral mc of the tuning range in 1-mc steps. TENTH MCS: Selects and indicates the decimal portion of the operating frequency in either 100-kc steps or in a continuous sequence.
PRESET levers	Provides means of presetting one or two detented channels (par. 57).
METER (M–301)	Indicates transmitter r-f power output, filament continuity, and availability of d-c (85-volt) operating potential.
METER selector switch (S–301).	Connects METER to test points as indicated below: RF position: Connects meter to transmitter r-f output circuit. Positions 2 through 11: Connects meter to various filament circuits (par. 84). 90V position: Connects meter to 85-volt d-c supply circuit.
TR-ANT TUNE control (C–74).	Adjusts transmitter-antenna-circuit tuning. (This is an installation adjustment only.)
TRANS-ANT COUPLING control (L–23).	Adjusts coupling between transmitter output stage and antenna. (This is an installation adjustment only.)
REC-ANT TUNE control (C–1A).	Adjusts receiver-antenna-circuit tuning. (This is an installation adjustment only.)
AUDIO connectors (J–310 and J–311).	Provide means of connecting chest set (with headset-microphone), microphone, headset, handset, or speaker, for separate local monitoring or push-to-talk operation of the receiver-transmitter.
REC-TR CONTROL	A 9-pin multiconnector which serves to make connection between the control circuits in the receiver-transmitter to external components, such as control boxes, junction boxes, etc., as required by a particular installation.
POWER IN connector	A 14-pin multiconnector which serves to connect external plate, screen, bias, filament, and relay voltages to the receiver-transmitter circuits.
ANT connector	A small pin-type coaxial connector which routes the common transmitter and receiver antenna to contacts on the antenna switch-over relay in the set.
AUX REC-ANT connector	A binding post used to connect an auxiliary receiver, if used, with the antenna circuit of the receiver.

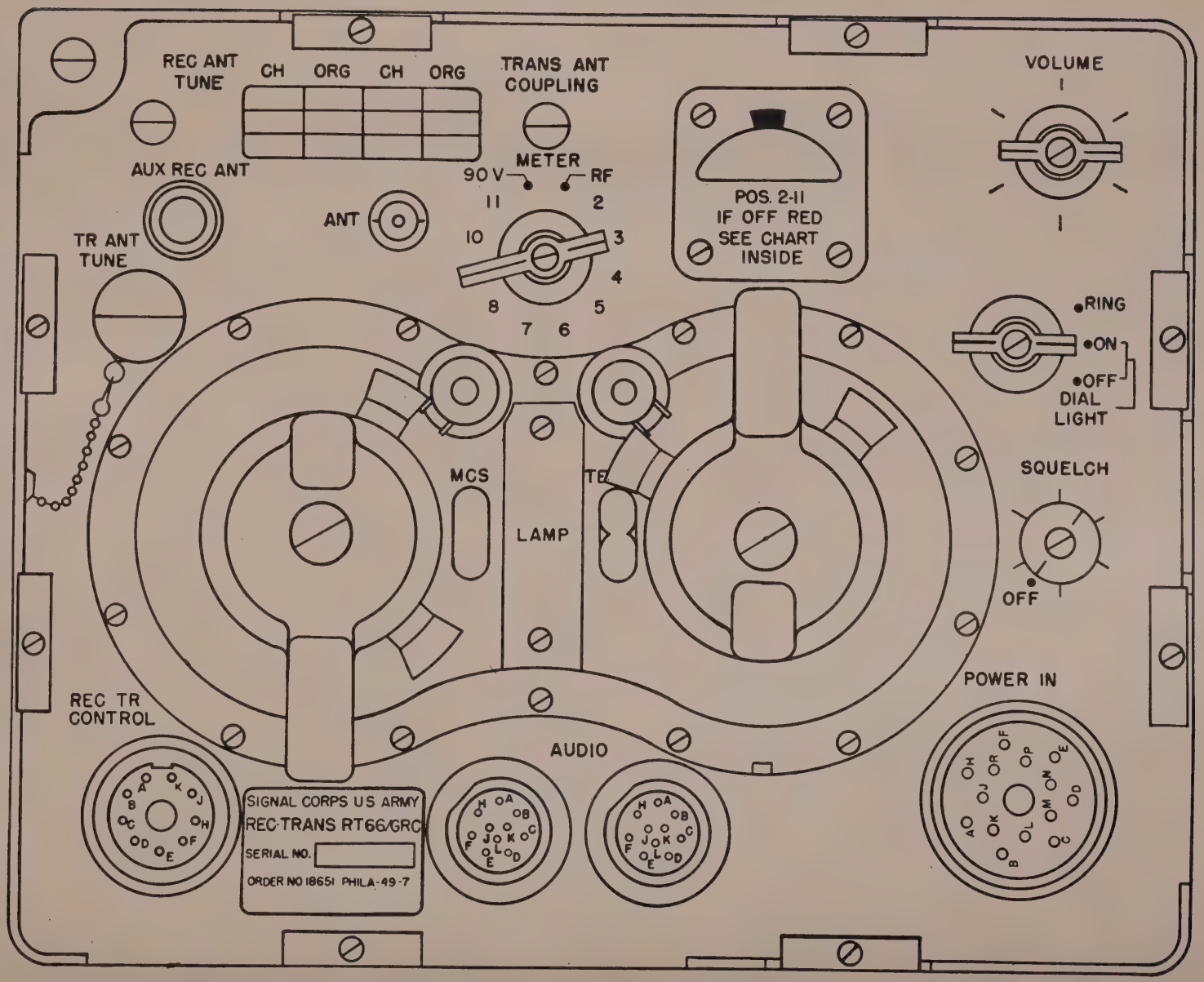


Figure 36. Set 1 panel.

49. Interphone Box

The controls on the interphone boxes (Control Box C–375/VRC) are illustrated in figure 37. Functions are listed in the following chart.

Note. Set 2 is not used in this system.

Control	Function
Selector switch (S–1)	Interphone operation is always possible (independent of selector switch). Selects input and output of receiver-transmitter, and interphone amplifier for transmission, intercommunication, and monitoring, dependent upon RADIO TRANS switch settings. Counterclockwise position: Selects the output of Set 1 and the interphone amplifier for monitoring; selects the input of Set 1 for transmission if the RADIO TRANS switch is also operated. Center position: Selects the output of both Sets 1 and 2 and the interphone amplifier for monitoring; selects the input of the interphone amplifier for intercommunication. Clockwise position: Selects the output of Set 2 and the interphone amplifier for monitoring; selects the input of Set 2 for transmission if the RADIO TRANS switch also is operated.
RADIO TRANS switch (S–2)	When a chest set is used and switch is in RADIO TRANS position, the chest set switches control interphone and push-to-talk operation. Center position: Selects the interphone amplifier for intercommunication. RADIO TRANS positions: Completes the Set 1 or Set 2 transmitting circuit as determined by the setting of the selector switch (above).
VOL. controls (R–1 and R–2)	Determine signal levels at PHONE jacks and audio connectors. (Level at each PHONE jack and audio connector is affected by the VOL. control nearest the jack or connector.)
Audio connectors (J–1 and J–2)	Provide for connection of Chest Set Group AN/GSA–6 (with Headset-Microphone H–63/U) for operation of the receiver-transmitters and interphone amplifier.
MIC. jacks (J–3 and J–4)	Provide for connection of Microphone T–17 for operation of receiver-transmitters and interphone amplifier. (Efficiency of operation will be affected by such usage and is not normally advisable if the standard audio accessories are available.)
PHONE jacks (J–5 and J–6)	Provide for connection of Headset H–16/U or Headset HS–30 in combination with Cord CD–933 for monitoring the receiver-transmitters and interphone amplifier. (Efficiency of operation will be effected by such usage and normally is not advisable if the standard audio accessories are available.)

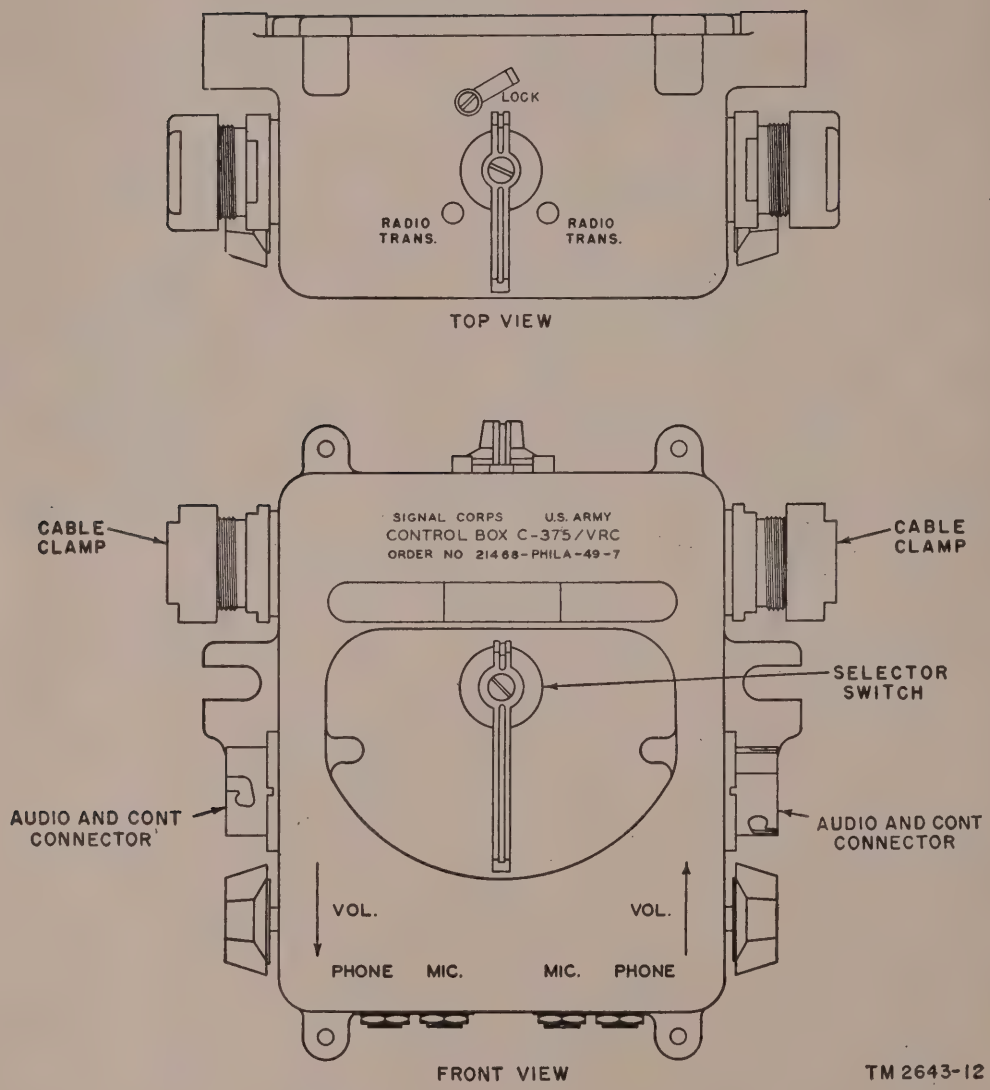


Figure 37. Panel views of interphone box.

50. Local Control C–434/GRC

Figure 38 illustrates the layout of controls and instruments on Local Control C–434/GRC. The following chart lists the functions of controls and instruments.

Note. Set 2 is not used in this system.

Control or instrument	Function
LOCAL switch (S–3)	Provides for push-to-talk operation of either Set 1 or Set 2 and for duplex telephone operation with the remote unit. SET 1: Allows push-to-talk operation of Set 1. SET 2: Allows push-to-talk operation of Set 2. TEL: Allows telephone operation with remote unit.
REMOTE switch (S–1)	In conjunction with controls at remote unit and at mounting, provides for remote control of power for the radio set and/or remote control of push-to-talk operation of Sets 1 and 2. Also provides means of limiting operation (at the remote unit) to telephone communication.
REMOTE switch (S–1)—Con.	TEL ONLY: Allows for telephone communication between local and remote control units, and breaks power and push-to-talk remote control circuits. SET 1 and 2: Provides for remote control of push-to-talk operation of Sets 1 and 2. SET 1: Provides for remote control of power for the radio set and push-to-talk operation of Set 1. SET 2: Provides for remote control of power for the radio set and push-to-talk operation of Set 2.
LINE L1 and L2	Provide telephone-line connections.
Ringing generator	Provides means of sending a ringing signal to the remote unit.
CALL LIGHT (E–3)	Indicates (when lit) that a ringing signal is being received from the remote unit. (CALL LIGHT indication can be replaced by a bell, by means of an internal switch.) Dimmer control provides for masking glow of the lamp.
AUDIO connector (J–1)	Provides means of connecting a handset or chest set (with headset and microphone) for telephone communication and push-to-talk operation of the radio set.

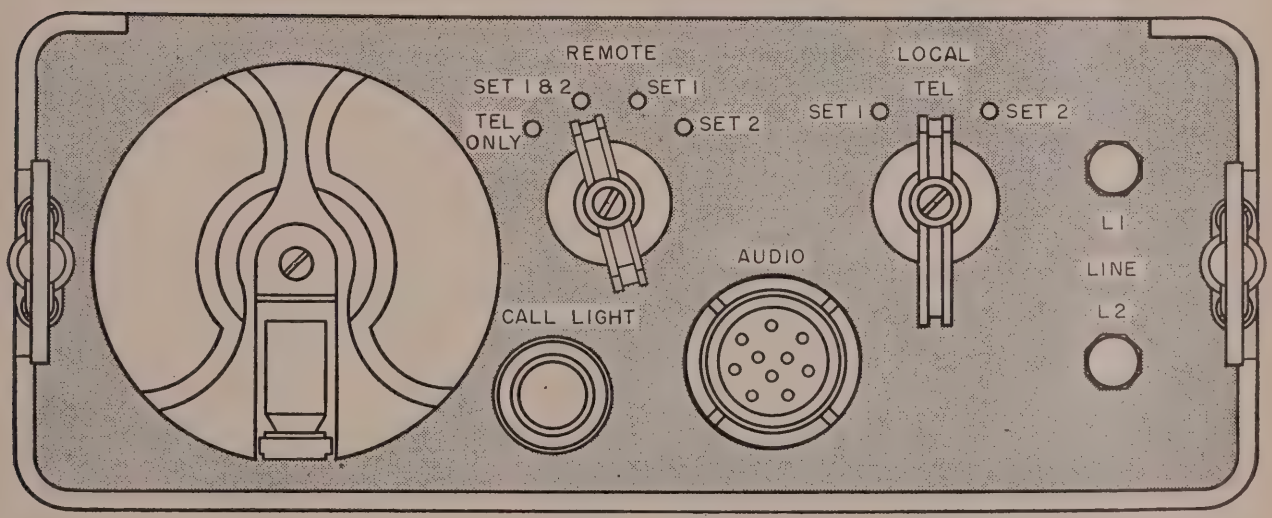


Figure 38. Panel view of local control unit.

51. Remote Control C–433/GRC

Figure 39 illustrates the controls and instruments on Remote Control C–433/GRC. The following chart lists the functions of controls and instruments.

Note. Set 2 is not used in this system.

Control or instrument	Function
SELECTOR switch (S–2)	In conjunction with controls at local units, and the mounting switch provide for remote control of power for the radio set and/or push-to-talk operation of Sets 1 and 2; also provides means of limiting operating to telephone communication. Right write-in position: A power-off position or Set 2 remote control position depending upon setting of REMOTE switch in local control unit.* Left write-in position: A power-on position, or a remote control position for Set 1, depending upon setting of REMOTE switch in local control unit.* TEL position: limits operation to telephone communication between local and remote units.
LINE L1 and L2	Provide telephone-line connections.
Ringing generator	Provide means of sending a ringing signal to the local control unit.
CALL LIGHT (E–3)	Indicates (when lit) that a ringing signal is being received from the local unit. (CALL LIGHT indication can be replaced by a bell by means of an internal switch.) Dimmer control provides for masking glow of the lamp.
AUDIO connector (J–1)	Provides means of connecting a handset for telephone communication and operation of the radio set.

*The functions of the write-in positions will be reversed by the reversal of the telephone-line connections at either the local or remote control unit.

52. Chest Set Group AN/GSA–6

The controls on the Chest Set Group AN/GSA–6 are shown in figure 11. The following chart lists the functions of the controls.

Control	Function
RADIO switch (S–1)	In conjunction with the controls at the mounting and the local control box, and the HOLD ON switch (below), provides for push-to-talk control of SET 1 or interphone operation. Normally in the interphone position, depressed for radio operation. Incorporates locking features which are described in paragraph 18.
HOLD ON switch (S–2)	In conjunction with the controls at the mounting and local control box, and the RADIO switch (above), provides for interphone or push-to-talk operation of Set 1. This switch is of the momentary contact type.
LOCK ON switch	Performs the same function as the HOLD ON switch but locks into position after it has been initially depressed. HOLD ON switch must be depressed to release this. A locking feature, described in paragraph 18, permits disabling this switch.

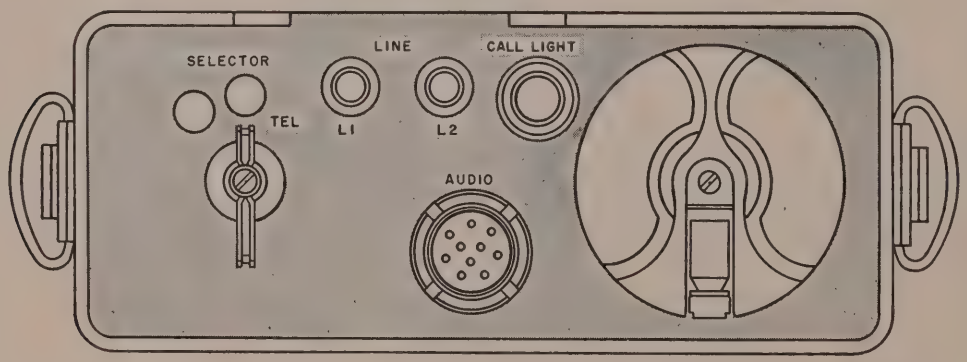


Figure 39. Panel view of remote control unit.

53. Operational Procedures

a. Operation of the radio sets involves the following basic procedures:

(1) Start-stop operations.
(2) Squelch adjustments.
(3) Volume-level adjustments.
(4) Tuning.
(5) Transmit-control operations.

b. The first four of the above listed procedures generally are local operations (performed at the panels of the various major units) and are not necessarily repeated during a normal operating period. This is with the possible exception of remote control. (It may be necessary to repeat tuning and squelch adjustments as the occasion demands.) The transmit-control operations are performed at one or the other of the control units and are continually repeated during normal operating periods.

c. To facilitate ready reference, the local operations and the transmit-control operations are discussed under separate headings in paragraphs 54 through 59.

54. Preliminary Starting Procedure

The preliminary starting procedure prepares the equipment for routine operation by setting controls so that routine starting and stopping may be limited to use of the OFF-REMOTE-ON switch on the mounting. Unless control settings are disturbed subsequent to shut-down of the equipment, it will not be necessary to repeat the preliminary starting procedure during routine operation.

a. With the OFF-REMOTE-ON switch of the mounting in the OFF position, place the OFF-INT-RT-70 switch of the interphone amplifier in the INT position.

Caution: Do not use the RT–70 position of this switch, since without the Receiver-Transmitter RT–70/GRC in the system, thermal relay D/K–1 in the amplifier may be damaged.

b. Turn the OPERATE switch of the Set 1 power supply to the TRANS & RECEIVE position.

c. Turn the TRANS POWER switch of the Set 1 power supply to the HIGH position.

d. Turn the SQUELCH control of Set 1 to the maximum clockwise position.

55. Routine Starting Procedure

When the controls have been set (or left set) as outlined in the preliminary starting procedure, apply power to the radio set by placing the OFF-REMOTE-ON switch of the mounting in the ON position.

56. Squelch and Volume-level Adjustments

The SQUELCH control of Set 1 should be set as soon as the equipment is placed in operation. The set should be checked periodically to insure operation at maximum sensitivity for the particular noise conditions present. Set the controls as outlined below.

a. Provide a monitor for the receivers. The monitor may be a chest set (with headset and microphone) connected to the AUDIO connector on the local control unit or interphone box. If an interphone box is used, turn the selector switch of the box to the left position (SET 1+INT).

b. Turn the Set 1 SQUELCH control counterclockwise until noise is audible in the headset. Note the approximate noise level present in the headset. Then advance the control in a clockwise direction to the point at which the receiver quiets.

Note. When the tuning of the set is changed, it may be necessary to reset the SQUELCH control.

57. Tuning Set 1

Once the antenna circuits have been properly tuned (par. 35), Set 1 can be tuned to any desired channel frequency by merely turning the MCS and TENTH MCS controls to the proper detent positions (*a* below). Continuous tuning between channels is possible by means of the procedure outlined in *b* below. Any two detented channels may be preset for rapid selection by means of the procedure outlined in *c* below.

a. Channel Tuning. Channel tuning is possible at every 100-kc interval between the lower and upper ends of the tuning range.

(1) To obtain detent operation of the tuning mechanism, if the unit was previously set up for continuous tuning, rotate the TENTH MCS control to the extreme clockwise position. The control should snap into position indicating that the mechanism is set up for detent operation.

(2) Turn the MCS control until the MCS dial indicates the integral portion of the desired frequency, for example, until the dial indicates 24 when the desired frequency is 24.8 mc.

(3) Turn the TENTH MCS control until the TENTH MCS dial indicates the decimal portion of the desired frequency, for example, until the dial indicates 8 when the desired frequency is 24.8 mc.

Note. When turning the TENTH MCS control, do not hold the MCS control. Holding the MCS control will affect the calibration of the tuning controls.

b. Continuous Tuning. Continuous tuning throughout the range of Set 1 is possible by releasing the channel-detent mechanism of the TENTH MCS dial.

(1) Turn the MCS control (as for channel tuning) until the MCS dial indicates the integral portion of the desired frequency.

(2) Turn the TENTH MCS control to the extreme counterclockwise position to release the detent mechanism.

(3) Turn the TENTH MCS control clockwise until the TENTH MCS dial indicates the decimal portion of the desired frequency. (Calibration marks between the major 100-kc (.1-mc) divisions represent 25-kc (.025-mc) intervals; when the MCS dial indicates 24, a frequency of 24.85 mc is selected by turning the TENTH MCS control until the second calibration mark between 8 and 9 appears opposite the indicator on the TENTH MCS dial.)

c. Presetting Detented Channels. Presetting is obtained by means of stops which limit the rotation of the tuning knobs. The stops can be swung into place for presetting (or removed when the presetting feature is not desired) by means of adjusting knobs. When in place for presetting, the stops will engage the green and the red levers on the tuning controls as the controls are rotated. The positions of the red and green levers can be changed so that the stops will function for any desired frequency. To preset any two frequencies, perform the following steps.

(1) Turn the MCS and TENTH MCS tuning controls until the higher of the desired frequencies is indicated on the tuning dials.

(2) Pull on the stop adjusting-knobs (against the spring tension which holds them locked against the panel) and turn the knobs so that the stops are positioned to engage the green and the red preset levers. Make certain that the stops lock into position.

(3) Loosen (but do not remove) the screw which secures, the MCS tuning control.

(4) Turn the green lever on the MCS control in a clockwise direction until it strikes against the stop. Hold the lever against the stop and tighten the screw on the tuning control.

(5) Loosen (but do not remove) the screw which secures the TENTH MCS tuning control.

(6) Compare the tenths portions of the two frequencies which are to be preset and set the green preset lever on the TENTH MCS control in one of the following ways:

(*a*) If the tenths portion of the higher preset frequency is higher than the tenths portion of the lower preset frequency, turn the green lever in a clockwise direction until it strikes the stop. Hold the lever against the stop and tighten the screw on the tuning control.

(*b*) If the tenths portion of the higher preset frequency is lower than the tenths portion of the lower preset frequency, turn the green lever in a counterclockwise direction until it strikes the stop. Hold the lever against the stop and tighten the screw on the tuning control.

(7) Turn the MCS and TENTH MCS controls until the lower of the desired frequencies is indicated on the tuning dials.

(8) While holding the green lever in place, loosen the screw on the MCS tuning control and turn the red lever in a counterclockwise direction until it strikes the stop. Tighten the screw on the tuning control.

(9) The setting of the red lever on the TENTH MCS control depends upon the setting of the green lever ((6) above). If the green lever was set in a counterclockwise posi-

tion, set the red lever in a clockwise position and vice versa.

Note. In describing the presetting procedure, it was assumed that the green preset levers would be used for the higher frequency and the red levers for the lower frequency. The opposite convention is equally suitable, but consistency in either convention is desirable.

58. Operation From Interphone Box

a. Modes of Operation. When power has been supplied to the radio sets, squelch adjustments have been made, and Set 1 has been tuned, the following modes of operation are possible at the interphone box.

(1) Monitoring of Set 1.
(2) Push-to-talk operation of Set 1.
(3) Interphone facilities between interphone boxes.

b. Connection of Audio Accessories. For all modes of operation, connect Chest Set Group AN/GSA–6 to one of the audio connectors on the interphone box and connect Headset-Microphone H–63/U to the chest set. Lock the RADIO TRANS switch of the interphone box in the RADIO TRANS position. For additional monitoring facilities, a second chest set group may be connected to the other audio connector on the interphone box.

c. Monitoring. To monitor Set 1, turn the selector switch to the left-hand (counterclockwise) position. Adjust the volume level by means of the VOL. control next to the audio connector being used.

d. Interphone Operation. Interphone reception is possible for any position of the selector switch. Transmission is possible in the SET 1+INT position. To communicate with an operator at any interphone box, press the push-to-talk switch on the chest set and talk into the microphone. The operator can *break-in* on a conversation at any time without waiting for the sending party to stop talking. *Do not press the RADIO push-button switch on the chest set. If the selector switch is in the left-hand position, the transmit-control circuits will be operated.*

e. Push-to-Talk Operation. For push-to-talk operation of Set 1, turn the selector switch to the left-hand position, press the push-to-talk switch and the push-button RADIO switch on the chest set, and talk into the microphone. Release the chest set switches to listen. The internal wiring of the interphone box is arranged to allow an operator to hear an interphone signal regardless of the position of the selector switch. In the SET 1+INT position of this switch, confusion may arise as to which signal is the interphone and which signal is the radio when both signals are present. When such a case arises, turn the selector switch to the center, SET 1+SET 2+INT, position and listen to the two signals. The louder of the two is the interphone signal. After an identification has been made, return the selector switch to the SET 1+INT position before attempting to transmit on Set 1.

59. Operation from Control Group AN/GRA–6

a. Modes of Operation. Although Control Group AN/GRA–6 is provided mainly to allow remote operation of the radio sets from points up to 2 miles away from the installation, local as well as remote operating facilities are available. The complete facilities are as follows:

(1) Simultaneous monitoring of received signals at both local and remote units.
(2) Local push-to-talk operation of Set 1.
(3) Telephone communication, including ringing, between local and remote units.
(4) Remote push-to-talk operation of Set 1.
(5) Remote control of power for the radio set and remote push-to-talk operation of Set 1.

b. Installation. Turn the OFF-REMOTE-ON switch of the mounting to OFF and install Control Group AN/GRA–6 as outlined in paragraph 37. When the installation is completed, turn the OFF-REMOTE-ON switch to the REMOTE position.

c. Monitoring. It is possible to monitor the output of the receiver at either the local or remote control unit with the REMOTE switch set at any position but TEL ONLY. The setting of the LOCAL switch should be TEL.

d. Local Push-to-Talk Operation.

(1) Set the REMOTE switch to SET 1 & 2.
(2) For push-to-talk operation of Set 1, hold the LOCAL switch in the SET 1 position, press the push-to-talk and RADIO switches on the chest set, and talk into the microphone. Release the chest set switches to listen.

Note. The RADIO switch on the chest set may be locked in the RADIO position for convenience by means of the internal adjustment (par. 18). This switch is normally in the interphone position.

e. Telephone Communication. Telephone communication between local and remote units is possible for any setting of the REMOTE switch, but the selector switch at the remote unit must be in the TEL position. When the REMOTE switch is in the TEL ONLY position, only telephone operation is possible. When the SELECTOR switch at the remote unit is in the TEL position, telephone communication is the only operation possible from the remote unit; as long as the REMOTE switch is at the SET 1 & 2 position, however, local push-to-talk operation of the receiver-transmitter is possible. Telephone operation is as follows:

(1) To send a ringing signal in either direction, turn the crank of the ringing generator at the sending unit (local or remote). Either a CALL LIGHT will glow or a bell will ring at the receiving end, depending upon the setting of internal switches in the local and remote units.

Note. Whenever a ringing signal is to be sent in either direction, the REMOTE switch on the local control unit should be in the TEL ONLY position. If this switch is set in the SET 1 or the SET 1 & SET 2 position when a ringing signal is sent, transmission of the ringing signal will occur. As a precautionary measure, always keep the REMOTE switch in the TEL ONLY position except when actually transmitting a signal.

(2) To communicate, press the push-to-talk switch on the handset (at the remote unit) or the push-to-talk switch and RADIO switch on the chest set (at the local unit) and talk into the mouthpiece or microphone. Full duplex operation is possible; it is not necessary to release the push-to-talk switches to listen.

f. Remote Push-to-talk Operation. The operator at the remote unit can inform the local operator by telephone of the mode of operation desired.

(1) Place the REMOTE switch of the local unit in the SET 1 & 2 position.

(2) For remote push-to-talk operation of Set 1, place the SELECTOR switch of the remote unit in the left-hand write-in position, press the push-to-talk switch on the handset, and talk into the mouthpiece. Release the push-to-talk switch to listen.

Note. If the telephone line connections at either unit are reversed, the right-hand write-in position will control Set 1, and the left-hand write-in position will be blank. Operation will be unaffected otherwise.

g. Remote Power Control and Push-to-talk Operation of Set 1. The operator at the remote control unit must set up the mode of operation prior to going to a remote position. If there are two operators available, the remote operator only need call in by the telephone system to the local operator for the setting of the mode of operation that is desired.

(1) Turn the mounting switch to the REMOTE position.

(2) Place the REMOTE switch on the local local control unit to the SET 1 position.

(3) Place the SELECTOR switch at the remote unit in the left-hand write-in position. Press the puch-to-talk switch on the handset momentarily. If power is not applied to the radio set (as determined by noise from set either momentary or extended, depending on squelch setting), the telephone line connections are reversed. Reverse and repeat action.

(4) After power is applied, puch-to-talk operation of Set 1 is possible by pressing the push-to-talk switch and talking into the microphone. To listen, release the switch.

(5) To remove power from the radio set, turn the SELECTOR switch on the remote unit to the right-hand write-in position and press the push-to-talk switch on the handset momentarily.

Note. The use of the right-hand write-in position as *a power off* position, and the left-hand write-in position as *a power on* position is chosen for convenience. If the telephone line were reversed, the functions of these two switch positions are merely reversed.

60. Stopping Procedure

a. To remove power from the entire radio set, place the OFF-REMOTE-ON switch of the mounting in the OFF position. To remove power from a single unit, leave the OFF-REMOTE-ON

switch in the ON position and operate the appropriate unit switch as indicated in *b* through *d* below.

b. To make the Set 1 transmitter inoperative, place the OPERATE switch of the Set 1 power supply in the RECEIVE position.

c. To remove all power from Set 1, place the OPERATE switch of the Set 1 power supply in the OFF position.

d. To remove power from the interphone amplifier, place the OFF-INT-RT-70 switch in the OFF position.

Note. When the interphone amplifier is turned off, it will be impossible to monitor any of the sets at the interphone box, the local control unit, or the remote control unit.

61. Miscellaneous Applications

a. Low Power Operation of Set 1. If it is desired to operate Set 1 for short range communication, the power output can be reduced by placing the TRANS POWER switch of the Set 1 power supply in the LOW position.

b. Panel Operation. Set 1 can be operated locally by using a chest set (with headset and microphone) or a handset connected to an AUDIO connector on the front panel. In Set 1, which has two AUDIO connectors, a microphone and headset or microphone and loudspeaker may be used. The interphone amplifier can be used as another interphone station by using a chest set (with headset and microphone) at the panel-mounted AUDIO connector.

CHAPTER 4
THEORY OF OPERATION

Section I. INTRODUCTION

62. Scope

a. System theory is presented to provide an understanding of how the several units are interrelated in the various operations of the radio sets. Such an understanding should be an effective aid in trouble shooting the equipment to isolate a defective unit and, in some cases, to isolate a defective part within a unit.

b. Detailed circuit theory of individual units is not discussed, except as the units are interconnected in a common circuit. For example, the microphone circuits of Set 1 are described since they are interconnected with the control units through the mounting; details of the Set 1 i-f amplifier are not important for system understanding and therefore are not discussed. Most of the information presented in this chapter is concerned with system applications of the several units. Complete details on the individual units are published in separate technical manuals. To provide a general acquaintance with the individual units, block diagrams of the major units are supplied in section II of this chapter and schematic diagrams of all units are included at the end of the manual. It should be noted that units used in this system also are used in other systems and, as a consequence, some have switch positions, junction points, etc., which have no apparent application. If a switch position, junction point, etc., should appear in an illustration and the text carries no explanation, it should be assumed that it has no relation to the system under discussion.

63. Basic System

a. Basically, each of the radio sets consists of one receiver-transmitter and an interphone amplifier with speech-input and monitoring facilities. These basic units are the essentials of the systems and the power supplies, cables, mountings, and miscellaneous equipment are supplied to make the basic units perform their function of transmitting, receiving, or monitoring.

b. In an actual system installation, microphone, and headset facilities are provided at each interphone box (Control Box C–375/VRC) and the switching provisions on the box allow selection of the mode of operation; namely, transmission on Set 1, interphone operation, or monitoring. The control facilities are extended from the individual units to the interphone box through Mounting MT–297/GR and interconnecting cables (fig. 28).

c. An adaptation of the basic system is the extension of the microphone and monitoring facilities to a remote point by means of telephone lines. Control Group AN/GRA–6 is provided to accomplish this function.

64. System Diagrams

a. Three diagrams (figs. 40, 41, and 42) are used to illustrate system interconnections and functioning. Complete power distribution circuits are shown on figure 40. Figure 41 illustrates the power distribution and control circuits within the local and remote control units. Indications have been made to show where these circuits connect into the system depicted in figure 40. When the local and the remote units are used, the complete circuits, as would be traced from the vehicle battery through the remote control, are partly in figure 40, and partly in figure 41. Figure 42 illustrates the monitoring facilities that are available.

b. In figure 40, the control unit used is Control Box C–375/VRC. This figure illustrates push-to-talk operation from the interphone box. Using figures 40 and 41, in conjunction with one another, will illustrate the operations that may be obtained from the local and the remote control units. Figure 41 illustrates telephone operation between the local and the remote units.

c. Figure 42 illustrates all of the monitoring facilities which are available in the radio sets and

the interconnections and switching which are necessary to utilize these facilities.

d. In paragraphs 65 through 74, the system diagrams are discussed in detail for each operational function. By following the discussion and the diagrams, it should be possible to determine what happens when each switch is thrown or pressed, what voltages are applied to what stage, how the microphone circuits are completed, the disposition of a received signal (from the output of the receiver), and other system functions. The passage of a signal through the transmitter (microphone to antenna) or the path of a received signal (antenna to receiver output circuit) is not discussed. Such detail is peculiar to the units (not the system) and, generally, is covered in section II of this chapter. Complete details are published in separate manuals.

65. Systems Legend

a. A system legend has been devised and used on the system diagrams (figs. 40, 41, and 42) to facilitate circuit tracing from unit to unit. Because each circuit is completed, generally, through one or more units, and similar reference symbols are used within each unit, it is impossible to tell, without some form of legend, when a circuit leaves one unit and enters another.

b. As indicated on the legends, a letter has been used to identify each unit and the letter has been prefixed to the reference symbol of the part in a particular unit. Thus, in the reference symbol H/P–4B at the upper left-hand corner of figure 40, H indicates Mounting MT–297/GR, P–4 is the reference symbol for a plug on the mounting (the termination of one of the mounting cables), and B indicates terminal B of the plug. Interconnection of H/P–4B and D/J–6B indicates that the circuit is continued to terminal B of receptacle J–6 in AF Amplifier AM–65/GRC.

c. To correlate the electrical interconnections with the physical interconnections, the following chart indicates the cable and plug connections made between the mounting and other units.

Mounting cable	Cable termination*	Mating connector		
		Receptacle	Unit	Receptacle designation
W–1	P–1	J–1	Auxiliary receiver	POWER IN.
W–2	P–2	J–8	Auxiliary receiver	REC CONTROL.
W–3	P–3	J–312	Set 1	REC-TR CONTROL.
W–4	P–4	J–6	Interphone amplifier	POWER IN.
W–5	P–5	J–1	Set 1 power supply	POWER IN.
W–6	P–6	J–4	Interphone amplifier	REC-TR CONTINUED
W–7	P–7	J–2	Interphone amplifier	INT CONTINUED
W–8	E–8 & E–11		Battery	

*Refer to figures 21, 28, and 74.

Note.—Auxiliary receiver is not used in this system.

Section II. POWER DISTRIBUTION AND PUSH-TO-TALK CONTROL CIRCUITS

66. Primary Power Application

(fig. 40)

When the OFF-REMOTE-ON switch of the mounting is placed in the ON position, relay H/K–1 is connected across the battery in series with fuses H/F–1 and H/F–2, the switch contacts, and resistor H/R–3 (In 12-volt systems, R-3 must be short-circuited). Contacts of H/K–1 close to apply battery voltage to two supply buses (at the top of the drawing) which connect the battery circuit to the Set 1 power supply and the interphone amplifier. Closure of the relay contacts also completes a circuit for lamp H/E–7 (on the panel of the mounting) which indicates that power is available at the output terminals of the mounting.

67. Interphone Amplifier

(fig. 40)

a. Power Input. When the OFF-INT-RT-70 switch (D/S–2) on the interphone amplifier is placed in the INT position, the battery circuit from the mounting is completed to the filaments of the amplifier, to a filament protection circuit, and to input connector U/X–1 of the plug-in power supply in the amplifier.

b. Amplifier Filaments. When the 6V–12V–24V switch (D/S–1) on the amplifier chassis is set at 12V, the amplifier filaments (V–1 through V–5) are connected directly across the battery through section 1B of the switch; the filament protection circuit (D/R–32, D/K–1, and associated resistors) is connected in parallel with the amplifier filaments by sections 1D and 1A of the same switch. For 24-volt operation, sections 1B and 1A connect the amplifier filaments in series with the filament protection circuit. Resistor D/R–36 parallels the filament protection circuit as a dummy load when the OFF-INT-RT-70 switch is in the INT position. Since Set 2 is not used in this system, the RT–70 position of the switch should not be used since the heating element D/K–1 may be damaged.

c. Amplifier Plate and Screen Supply. The vibrator power supply develops a 135-volt output which is used to furnish the plate and screen requirements of the amplifier tubes.

d. Monitoring. When filament, plate, and screen voltages have been made available as described above, the amplifier can monitor input signals from Set 1 (fig. 42). The amplifier cannot be used for interphone operation until the microphone and control circuits (*e* below) are completed. The signal path through the interphone amplifier may be traced through the block diagram (fig. 45). The output of the interphone amplifier is routed for monitoring to the audio connectors of the interphone boxes, the amplifier panel, and the AUDIO connector of the local unit. The signal supplied to the interphone boxes must be selected by the switch on the panel of the box (R/S–1 in fig. 42).

e. Interphone Microphone and Control Circuits.

(1) The battery voltage at terminal U/X–1 (3) of the plug-in power supply is routed through resistors D/R–28 and D/R–27 to the coil of relay D/O–1 (fig. 41). The relay circuit is not completed to ground, however, because of the open push-to-talk contacts of switch Y/S–2 on the chest set. In 12-volt circuits, resistor D/R–28 is short-circuited by a jumper on the plug-in power supply input connector.

(2) The microphone input circuit parallels relay D/O–1 and consists of dropping resistor D/R–2, audio choke D/L–2, microphone transformer D/T–1, and the microphone. Contacts of relay D/O–1 and a second set of push-to-talk contacts on Y/S–1 hold this circuit open during monitoring periods.

(3) When the push-to-talk switch is pressed, relay D/O–1 is energized and the microphone circuit is completed through the relay contacts and the push-to-talk contacts. Microphone excitation current flows through the carbon element of the microphone and talking into the microphone develops voice signals across transformer D/T–1. The interphone signal is amplified and routed to the AUDIO connectors at control points, as described in *d* above.

(4) The interphone circuits also can be completed through three paralleling circuits: through the center position of RADIO TRANS switch R/S–2, the RADIO contacts of Y/S–1, and the push-to-talk contacts of Y/S–2; through the center position of selector switch R/S–1, RADIO TRANS contacts of R/S–2, RADIO contacts of Y/S–1, and push-to-talk contacts of Y/S–2; or through an audio accessory connected to the panel-mounted AUDIO connector (D/J–1) on the amplifier.

68. Set 1 Receiving Circuits

(fig. 40)

a. Power Input Circuits. As soon as the OFF-REMOTE-ON switch (H/S–1) of the mounting is placed in the ON position, the battery circuit is completed to contacts of the 4-section OPERATE switch (E/S–1) in the Set 1 power supply. When the OPERATE switch is placed in either RECEIVE or TRANS & RECEIVE position, the Set 1 receiver-transmitter is ready for monitoring. As long as a push-to-talk switch or other transmit-control switch is not operated, operation is the same for either the RECEIVE or TRANS & RECEIVE position of the OPERATE switch. The RECEIVE position makes it impossible to transmit, even though transmit-control switches are operated.

b. Receiver Filament Circuits. In 24-volt systems, the battery voltage is applied through section ID of the OPERATE switch and dropping resistor E/R–39 to the receiver filament protection circuit and the receiver filaments. Ballast tubes

E/R–40 and E/R–31 maintain a constant voltage for the filaments despite variations of battery voltage. In 12-volt systems, the dropping resistor and one of the ballast tubes (E/R–40) are not used. The filament protection circuit utilizes thermal relay E/K–2 whose normally closed contacts short-citcuit resistor E/R–32. If an overvoltage occurs in the filament circuit, the thermal relay operates and its contacts open. Resistor E/R–32 is then placed in series with the filaments to absorb the overvoltage. The filament circuits completed are those of A/V–1 through A/V–4, A/V–101 through A/V–103, and A/V–107 through A/V–116. Complete circuit detail of the series-parallel filament arrangement is shown in figure 47. Dial LAMP A/E–313 is connected in parallel with the filaments of A/V–113 and A/V–114 in two positions of RING-DIAL LIGHT (ON-OFF) switch A/S–302. In the OFF position, dummy load A/R–304 is substituted for the lamp.

Note. For circuit details of the Set 1 power supply, refer to figures 76 and 77. A block diagram of the Set 1 power supply is shown in figure 43.

c. Receiver Plate and Screen Supply.

(1) The battery voltage is supplied through Section IC of the OPERATE switch to a l-v (low voltage) vibrator supply. The 135-volt output from the vibrator is filtered by choke E/L–12 and supplied through dropping resistor E/R–17 to the second a-f amplifier of Set 1 (A/V–116). Dropping resistors E/R–21 and E/R–22 are connected in series with voltage regulator E/V–4 between the 135-volt potential and ground (Resistor E/R–22 is in the circuit for the HIGH position of TRANS POWER switch E/S–2A; it is shorted out for low power operation since an increased drain is placed on the 85 volt power supply for that type of operation).

(2) The 85-volt potential at the plate of E/V–4 is used (during reception) as a source of screen and plate voltage for tubes A/V–1 through A/V–4, A/V–101 through A/V–103, A/V–107 through A/V–112, and A/V–115. Plate and screen voltages for A/V–1 and screen voltage for A/V–2 are applied through normally closed contacts (9–10) of relay A/O–101.

d. Monitoring.

(1) When the filament, plate, and screen potentials have been supplied as described above, the receiver of Set 1 is operative. Signals picked up by the receiver are routed from antenna to audio output circuits as indicated on the block diagram (fig. 45) and the schematic diagrams (figs. 79, 80, and 81) for Receiver-Transmitters RT–66/GRC, RT–67/GRC, and RT–68/GRC, respectively.

(2) The outputs of the first and second a-f stages, A/V–115 and A/V–116, respectively (fig. 42), are supplied to the phone and speaker terminals of the panel-mounted AUDIO connectors, A/J–310 and A/J–311. A headset may be used to monitor these signals.

(3) A fixed-level audio output from A/V–102 (fig. 42) is routed through normally closed contacts of H/O–1 in the mounting to the interphone amplifier. The output of the interphone amplifier is routed to the several control units for monitoring as indicated in figure 42 and explained in paragraph 67.

69. Set 1 Transmitting Circuits

(fig. 40)

a. Power Input Circuits. Until transmit-control circuits have been operated, the Set 1 power supply circuits for the Set 1 transmitting circuits remain unenergized. Battery voltage is supplied to Sections 1B and 1A of the OPERATE switch in the 150- and 300-volt vibrator circuits, but contacts of relay E/O–1, in the power supply, prevent the circuits from being completed. The circuit to relay E/O–1 in turn is broken by contacts of relay A/O–101 which is under control of the push-to-talk switch. The sequence of operation is described in the following subparagraphs.

b. Operational Controls. The following switches must be operated before the transmit-control circuits can be energized.

(1) Selector switch R/S–1 on the interphone box must be placed in the Set 1 (left-hand) position.

(2) Switch R/S–2 on the interphone box must be held or locked in the RADIO TRANS position.

(3) Switches Y/S–1 (RADIO) and Y/S–2 (push-to-talk) on the chest set must be pressed.

c. Relay A/O–301. Contacts of Relay A/O–301 switch the antenna from the receiver to the transmitter.

d. Relay A/O–1.

(1) Contacts 2–3 of relay A/O–1 close to shunt resistor A/R–109 across the squelch oscillator load resistor, A/R–110.

(2) Contacts 6–7 of relay A/O–1 close in the B+ leads of A/V–9 and A/V–10 and contacts 4–5 close in the screen circuit of A/V–11.

e. Relay A/O–101.

(1) Contacts 9–10 open and contacts 9–8 close to switch the 85-volt supply from receiver tubes A/V–1 and A/V–2 to transmitter tubes A/V–104A, A/V–105, A/V–106, and A/V–5 through A/V–8. If the RING DIAL LIGHT (OFF-ON) switch is held in the RING position, voltage also is made available to A/V–104B.

(2) Contacts 2–3 of relay A/O–101 open and contacts 2–1 close to switch the a-f input to A/V–115 from the normal receive tap on the discriminator output voltage divider to the lower voltage tap used for sidetone during transmission.

(3) Contacts 4–5 of relay A/O–101 close in the microphone circuit, and the filament lead to transmitter tubes A/V–5 through A/V–11 and A/V–104 through A/V–106.

(4) Contacts 6–7 of relay A/O–101 close to complete a circuit for relay E/O–1 in the power supply. Relay E/O–1 operates to complete the power input circuits for the transmitter filaments and the transmitter h-v (high-voltage) supplies.

f. Relay E/O–1.

(1) Contacts 2–3 of relay E/O–1 complete the battery circuit from Section ID of the OPERATE switch to the filaments and filament protection circuit for the transmitter. In 24-volt systems, dropping resistor E/R–36 and ballast tubes E/R–37, 38, 24, and 25 are included in the input circuit. In 12-volt systems, E/R–36 and ballast tubes E/R–37 and 38 are omitted. The filament protection circuits utilizes thermal relay E/K–1 which, when operated, causes resistor E/R–26 to be inserted in series with the transmitter filaments. The filaments supplied are those listed in paragraph e above. Complete filament circuit details are shown in figure 45.

(2) Contacts 4–5 of relay E/O–1 close to short-circuit resistor E/R–21 in the 85-volt supply circuit. This operation compensates for the increased drain on the 85-volt power supply during transmission.

(3) Contacts 7–8 and 9–10 of relay E/O–1 complete the battery input circuit from Sections 1B and 1A of the OPERATE switch to the 150-volt vibrator power supply and 300-volt vibrator power supply, respectively.

g. H-V Circuits.

(1) The output of the 150-volt supply furnishes operating voltage for tubes A/V–9 and A/V–10 during high-power operation (S–2A in HIGH position).

(2) The 150-volt potential also is connected in series with the 300-volt supply to furnish a 450-volt potential for the power amplifier, A/V–11. A tap on the 450-volt supply provides approximately 250 volts for the screen of A/V–11.

h. High Power Transmission. When the transmitter circuits have been energized as described in the preceding subparagraphs, the transmitter generates a carrier signal which may be modulated by talking into the microphone or by holding the RING-DIAL LIGHT (OFF-ON) switch in the RING position. The transmit-control circuits also can be energized by using a microphone at either of the panel-mounted AUDIO connectors A/J–310 or A/J–311.

i. Low Power Transmission. If the TRANS POWER switch (E/S–2) is placed in the LOW position, the following circuit changes are effected.

(1) The input to the 300-volt vibrator supply is broken by E/S–2B.

(2) Tube A/V–11 is switched from the 450-volt supply to the 150-volt supply by Section 1A of switch E/S–2A.

(3) Tubes A/V–9 and A/V–10 are switched from the 150-volt supply to the 85-volt supply.

(4) Resistor E/R–22, in the 85-volt supply lead, is short-circuited to compensate for the increased drain on the supply.

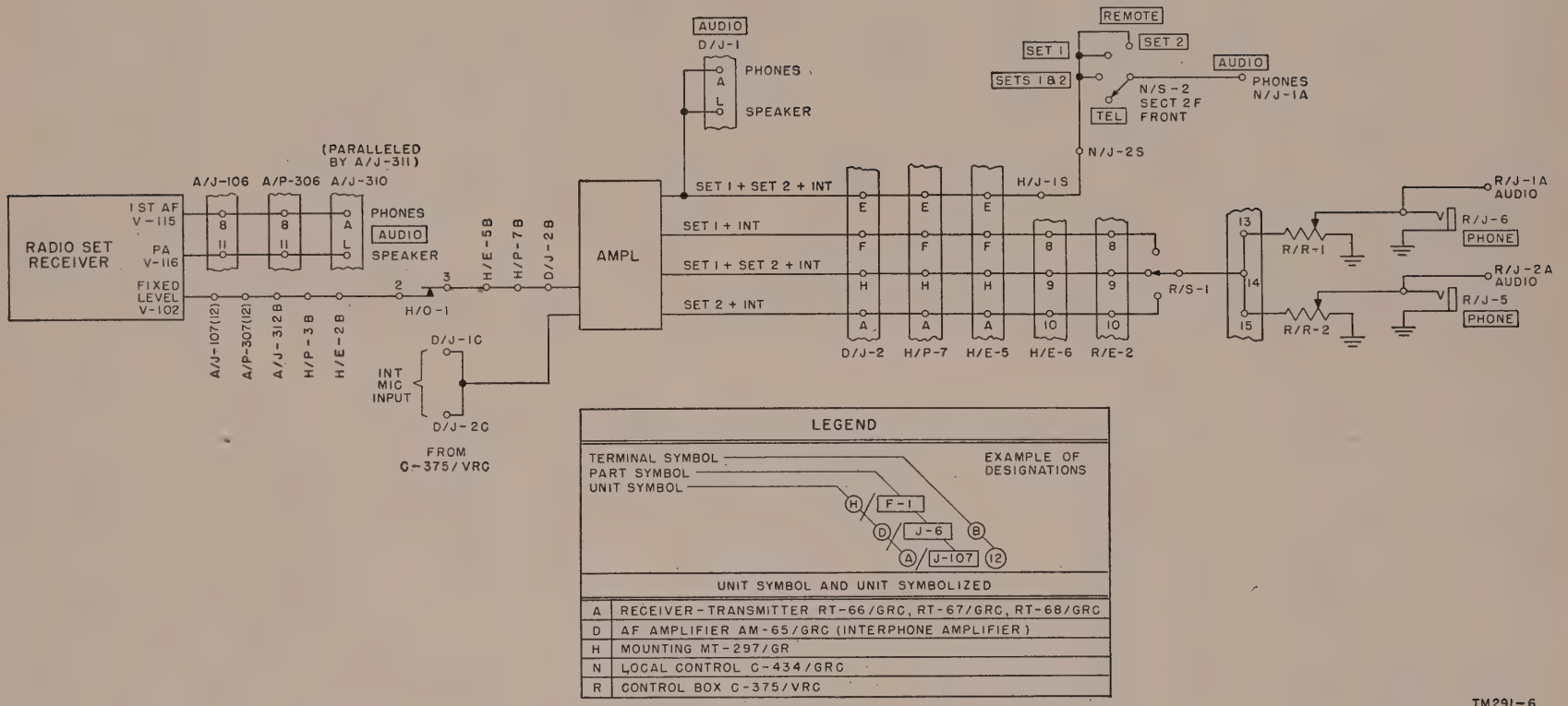


Figure 42. Monitoring circuits.

70. Ringing Circuit

(fig. 41)

a. It is always possible to ring from the local control unit to the remote control unit, or vice versa, when the units are connected by a telephone pair as indicated in figure 41. The ringing circuit is independent of the radio sets.

b. The ringing signal is transmitted in either direction through transformers N/T–1 and M/T–1 and the telephone line, and operates either a CALL LIGHT on the panel of the receiving unit or a bell within the receiving unit. An internal switch (N/S–1 or M/S–1) selects the lamp or bell in the local and remote units, respectively.

71. Telephone Circuit

(fig. 41)

a. Duplex telephone operation is possible provided the LOCAL switch (N/S–3) is left in the TEL position. Local batteries (BT–1 and BT–2) are supplied in each unit in series with the microphones. If a push-to-talk switch on the handset at either unit is pressed, and the operator talks into the mouthpiece, the voice signals will be coupled through the transformers and telephone lines to the earpieces at the receiving end.

b. The TEL ONLY position of the REMOTE switch on the local unit and the TEL position of the SELECTOR switch on the remote unit provide for telephone operation only. Radio operation also is possible for other positions of these switches (pars. 72 through 74).

72. Monitoring and Local Push-to-talk Operations

(figs. 40 and 41)

a. Monitoring and local push-to-talk operations are described for a REMOTE setting of the OFF-REMOTE-ON switch on the mounting, and a SET 1 & 2 setting of the REMOTE switch on the local control unit. The REMOTE switch completes the circuit for relay H/K–1 in the mounting (lower left-hand side of figures 40 and 41), and power is distributed to the interphone amplifier and all receiving circuits, as previously described. The sets are in a receiving condition and any signals received may be monitored at the interphone boxes and the local control unit (fig. 42). Section 2F front of the REMOTE switch (fig. 41) couples the signals from the interphone amplifier to the monitoring devices and the line transformer in the local unit. The signals also are coupled through the line transformers and telephone line to the earpiece at the remote unit (fig. 41).

b. If the LOCAL switch is turned to the SET 1 position, and the push-to-talk switch is pressed, sections 1C and 1B of the switch provide ground returns for the microphone and transmit-control lines, respectively, of Set 1. The Set 1 transmitting circuits are energized as described in paragraph 69*c* through *i*. Talking into the microphone at the local unit will cause modulation of the transmitted signal.

73. Remote Push-to-talk Operation

(figs. 40 and 41)

a. In remote push-to-talk operations, the ground returns for the transmitter audio-input and control lines are controlled by relays N/O–1 and N/O–2 which are in the local control unit, but whose control voltage is obtained from the remote unit through the telephone line. Relay N/O–2 is polarized, that is, it exerts either an attractive or a repelling force upon the contacts which it controls, depending on the polarity of the voltage impressed upon its coil. Relay N/O–1 is not polarized and exerts the same direction of force regardless of the polarity of the applied voltage. In the polarized relay the contacts, which operate in conjunction with the coil, remain in the position to which the action of the coil forces them until a voltage of opposite polarity is applied, whereupon they change position. This is by virtue of a magnetic latching mechanism. In the nonpolarized relay the contacts maintain the position into which they are forced by the magnetic action of the coil only as long as a voltage is impressed across the coil terminals. When the voltage is removed, they return to their normally open or normally closed position.

b. The polarity applied to relay N/O–2 is controlled by the REMOTE switch in the local unit and the SELECTOR switch in the remote unit. For remote push-to-talk operation (without power control), the REMOTE switch is left in the SET 1 & 2 position, so that the SELECTOR switch has complete control of the relay operation. For this system, the LOCAL switch setting is immaterial.

The functions performed by the left-hand and right-hand write-in positions of the SELECTOR switch at the remote unit are determined by the telephone line connections. If the line connections are reversed at either end, the functions of the positions became reversed. Since in this system only Set 1 is used, it should be determined by test which write-in position completes the Set 1 power and audio lines. This position then should be labeled Set 1, and the other write-in position should be labeled OFF.

c. In figure 41 the left-hand write-in position is the Set 1 position. When the SELECTOR switch at the remote unit is placed in this position, and the remote push-to-talk switch is pressed, a 45-volt battery is connected across the line so that line L2 is negative with respect to L1. Relay N/O–2, with this polarity applied to it, operates to close contacts 6–4 and open contacts 7–6. Relay N/O–1 is operated and its contacts function, that is, 7–6 close and 6–4 open. The ground return for the power line of Set 1 is now complete. In addition, the opening of contacts 6–4 of N/O–1 has made telephone communication between the local and remote units impossible by removing the ground return of the primary of N/T–1. Contacts 5–8 of relay N/O–1 also closes to complete the a-f circuit for the Set 1 microphone line. When the remote operator talks into the microphone, the voice signals are coupled through windings 5–6, and 1–2, and 3–4 of transformer M/T–1 to the telephone line. At the local end of the line, transformer N/T–1 couples the signal to the Set 1 microphone line.

d. When the remote push-to-talk switch is released N/O–2 and N/O–1 are de-energized. Contacts 6–7 of N/O–1 open, 6–4 close, and 5–8 open. This breaks the a-f microphone circuit and control ground return lines for Set 1. Contacts 6–4 of relay N/O–2 remain latched in the closed position but have no effect on the circuit since contacts 6–7 of N/O–1 have broken the ground return. When the remote push-to-talk switch is again depressed N/O–2 will not operate, but since its contacts are already in position for operation of Set 1, only the operation of the contacts associated with N/O–1 are required to complete the ground returns for Set 1 control and microphone circuits. Placing the SELECTOR switch in the right-hand write-in position and pressing the remote push-to-talk switch will return the contacts of N/O–2 to the 6–7 position, and establish conditions necessary for the operation of a Set 2, but since no Set 2 is used in this system this position is not necessary for remote push-to-talk operation without power control.

74. Remote Power Control and Push-to-talk Operation

(figs. 40 and 41).

a. A third relay (N/O–3), which is also polarized, is effective in the remote control of power for the radio sets. Relays N/O–1 and N/O–2 function as before for control of the push-to-talk operation, but the REMOTE switch as well as the SELECTOR switch are both involved in the switching of the remotely located battery.

b. For remote control of power and remote push-to-talk control of Set 1, the OFF-REMOTE-ON switch on the mounting is placed in the REMOTE position, and the REMOTE switch of the local control unit is placed in the SET 1 position. Under these conditions, relay H/K–1 (at the left-hand side of figure 41) is de-energized and all power is removed from the radio set until relay N/O–3 is energized. If the SELECTOR switch at the remote unit is placed in the left-hand write-in position, and the remote push-to-talk button is pressed, the battery is connected across the line so that line L1 is positive with respect to line L2. Under these conditions, relay N/O–3 is energized and power is applied to the radio set. Relays N/O–1 and N/O–2 also are energized and all conditions are established for the transmission of signals from the remote position.

c. Releasing the push-to-talk switch will not remove power from the radio set because the contacts of N/O–3 remain latched in position until a voltage of opposite polarity is applied to the coil. This is done by returning the SELECTOR switch to the right-hand write-in position, now labeled OFF, and pressing the push-to-talk switch.

Section IV. UNIT THEORY

75. Scope

The discussion of unit theory is limited to block diagram analyses of the major units. Although the maintenance information included in this manual is at an organizational level only, familiarity with the block diagrams of the units should be helpful in trouble shooting. A knowledge of which tubes are receiving tubes and which tubes are transmitting tubes, for example, will aid in the replacement of parts for which the operator has running spares. The block diagrams are shown in figures 43 through 45. Complete schematic diagrams for all units are also included as additional information for maintenance personnel (figs. 69 through 81).

76. Set 1 Power Supply
(fig. 43)

a. Figure 43 is a functional block diagram of Power Supply PP–109/GR or Power Supply PP–112/GR. It shows the three h-v circuits and the three l-v circuits supplied from the storage battery input terminals. The h-v circuits are used to provide the plate, screen, and bias voltages for the receiver and transmitter circuits in Receiver-Transmitter RT–66/GRC, RT–67/GRC, or RT–68/GRC. The l-v circuits supply the receiver-transmitter filament and relay potentials.

b. The 85-volt circuit (E–3 and T–3) is energized whenever the OPERATE switch S–1 is in either the RECEIVE or TRANS & RECEIVE position. The other two h-v circuits, E–2 and T–2, E–1 and T–1, and the transmitter filament supply circuit, are energized when switch S–1 is in the TRANS & RECEIVE position and relay O–1 is energized. E–1 and T–1 are controlled also by TRANS POWER switch S–2, which must be in the HIGH position for E–1 and T–1 to operate.

c. The l-v circuits include: the receiver filament supply circuit with output at terminal L of J–2; the transmitter filament supply circuit with output at terminal N of J–2; and the relay supply circuit with output at terminal A of J–2.

d. Each of the h-v and l-v circuits is equipped with r-f noise suppression filters in both the input and output leads, and a-c ripple filters in the output of each circuit.

e. TRANS POWER switch S–2 consists of two sections, both of which are used in the h-v circuit. One section of S–2 is used to provide full or reduced voltages as required for HIGH or LOW power operation, respectively. The other section of S–2 opens the input to the transmitter h-v and bias supply circuits when the TRANS POWER switch is in the LOW position.

77. Set 1 Transmitting Circuits
(fig. 44)

The block diagram shown in figure 44 pertains equally to Receiver-Transmitters RT–66/GRC, RT–67/GRC, and RT–68/GRC. The transmitter circuits include a microphone input transformer, a reactance modulator (V–105 and V–106), a transmitter oscillator (V–104A), the common crystal oscillator-harmonic generator (V–3 and V–4), the transmitter harmonic amplifier (V–5), a mixer stage (V–6), an r-f stage (V–7 and V–8 in parallel), a driver stage (V–9 and V–10 in parallel), and the power amplifier stage (V–11), the transmitter antenna circuit, and the common receiver, transmitter antenna.

a. Transmitter Signal Path. Voice signals from an external source are applied through a microphone transformer to the input of the transmitter reactance modulator. Under control of the audio signals, the reactance modulator causes the frequency generated by the transmitter oscillator (section A of V–104) to vary up or down in accordance with the amplitude and frequency of audio signals. Modulation is represented by a shift in the frequency generated by the transmitter oscillator, and ultimately by a corresponding shift of the over-all carrier frequency. The output of oscillator V–104A and the output of harmonic amplifier V–5 are combined in the transmitter mixer stage V–6. A tuned circuit, using one section of tuning capacitor C–1, selects the desired sum frequency at the output of the transmitter mixer and applies it to the transmitter r-f amplifier stage V–7 and V–8. The output of this stage is tuned to resonance at the carrier frequency by capacitor C–1. Further amplification is provided by transmitter-driver stages V–9 and V–10, using a section of the r-f tuning capacitor C–1, and by the transmitter power amplifier stage, V–11. The amplified output is then routed through a tuned circuit to the antenna. The output circuit of the power amplifier uses a section of the main tuning capacitor C1, while the antenna circuit is tuned to resonance by the TR-ANT TUNE capacitor.

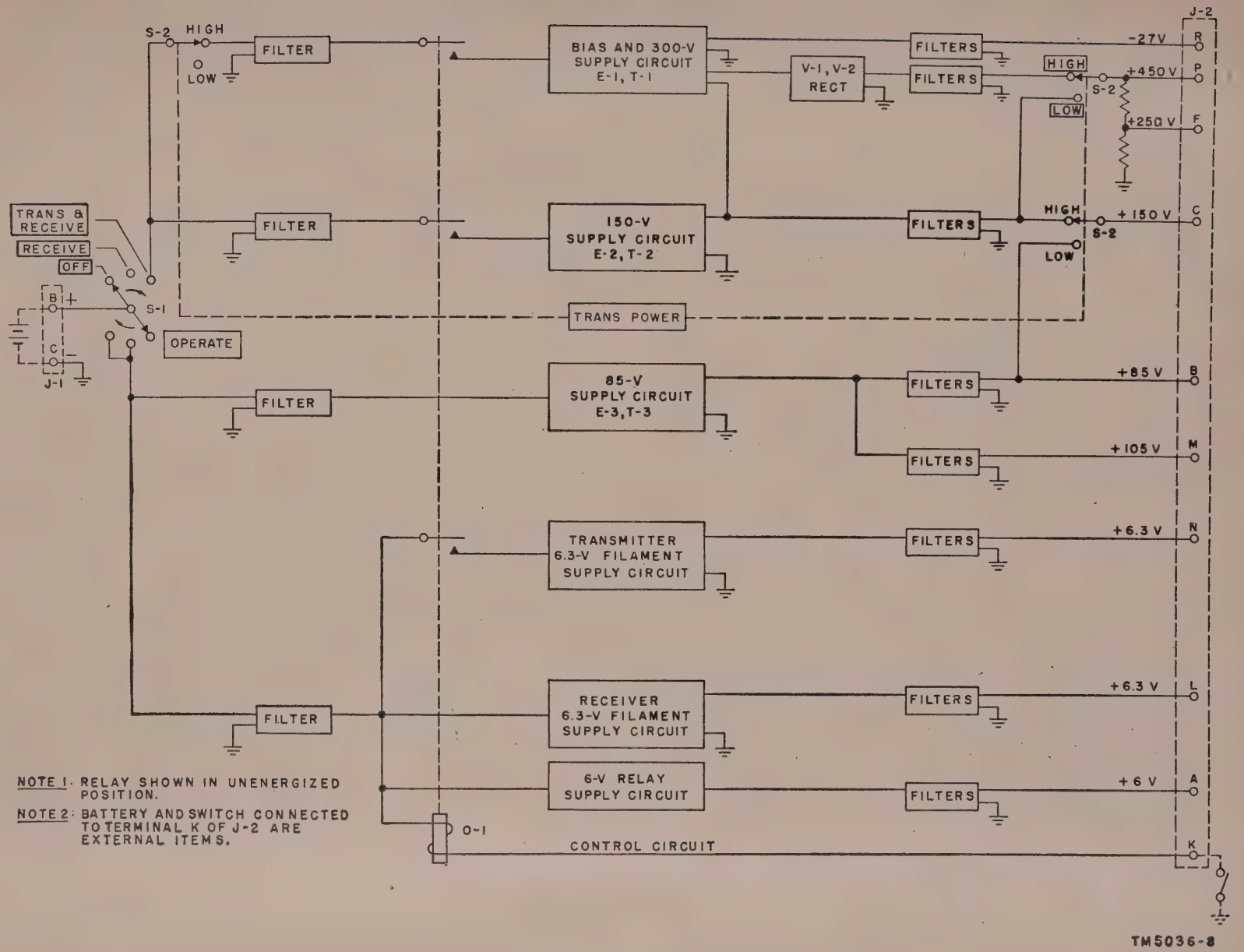


Figure 43. Set 1 power supply, block diagram.

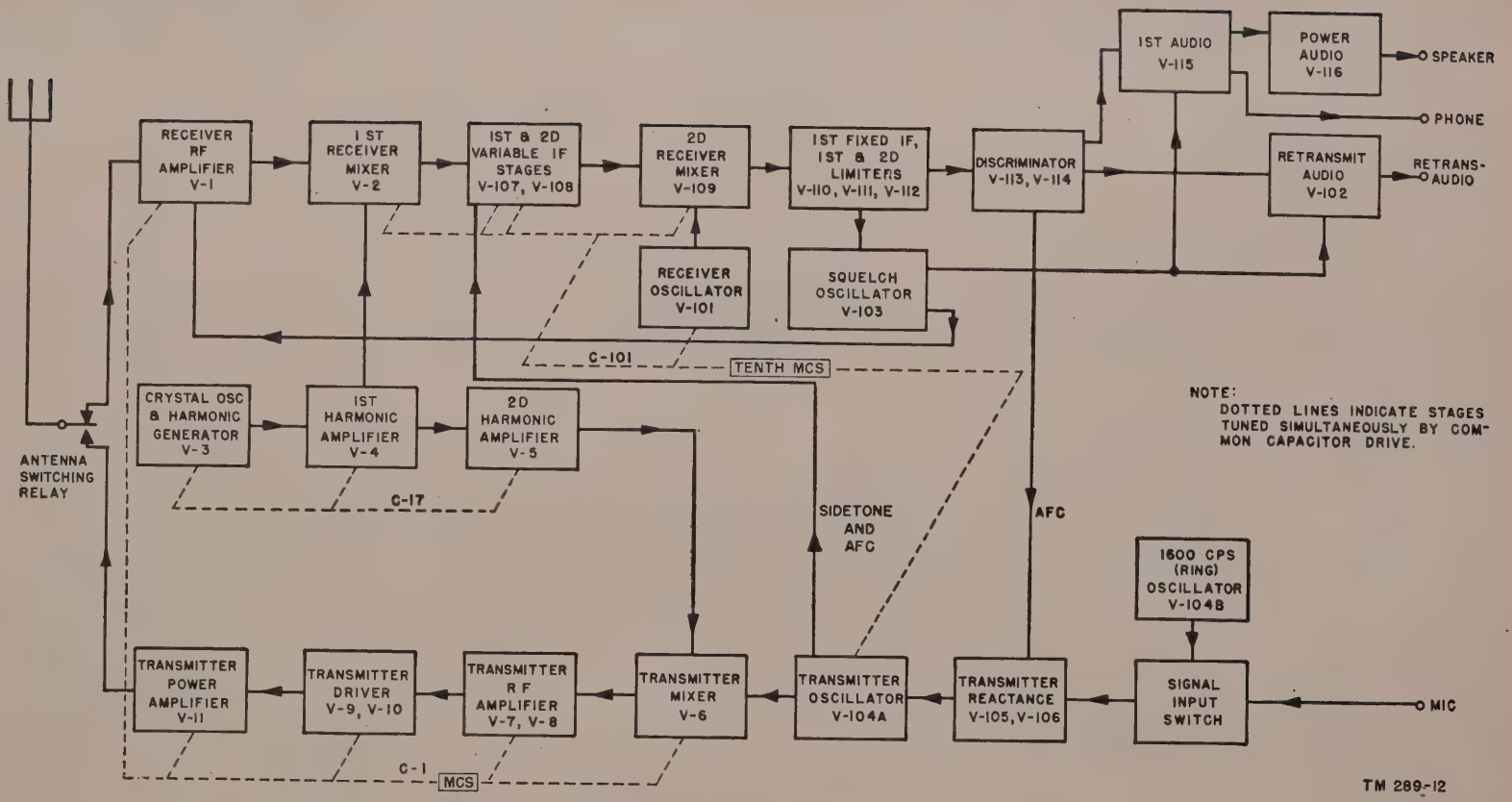


Figure 44. Set 1, block diagram.

b. Automatic Frequency Control. The purpose of the a-f-c (automatic frequency control) circuit is to maintain a constant transmitter-oscillator carrier frequency. The output of the transmitter-oscillator V–104A is picked up by the variable i-f stages in the receiver through stray coupling and fed to the rest of the receiver circuit. If the difference between the receiver-oscillator frequency (used as the standard) and the transmitter-oscillator frequency varies from the fixed i-f frequency, a voltage is developed in the discriminator circuit. This voltage is used as the a-f-c voltage and is fed to the transmitter reactance tubes, V–105 and V–106. The transmitter reactance stage then corrects the transmitter-oscillator frequency. The time constant of the a-f-c coupling circuit from the discriminator is such that normal modulation of the i. f. does not appear in the a-f-c voltage.

c. Sidetone. Sidetone voltage is obtained from the transmitter-oscillator, V–104A. This voltage is picked up by the variable i-f stages through stray coupling and is fed through the rest of the receiver circuit to the AUDIO output connector and fixed-level audio output terminals.

d. Ringer Circuit. A ringer circuit associated with the transmitter is energized when the RING-DIAL LIGHT (OFF-ON) switch is in the RING position. This switch has the same function for the ringing circuit as the push-to-talk button of the microphone has for the transmitter, since it causes the control relays to be energized when it is in the RING position. In addition, it applies power to the 1,600-cycle ringer oscillator (section B of tube V–104). The output of the ringer oscillator is applied to the microphone transformer. Signal transmission is accomplished as described in *a* above for any other audio signal.

78. Set 1 Receiving Circuits

(fig. 44).

The receiver is of the double-conversion superheterodyne type arranged to receive f-m signals. The term *double conversion* means that the incoming carrier signal beats with one local oscillator frequency to produce a first i. f. (between 4.45 and 5.45 mc); this frequency in turn beats with another oscillator frequency to produce a second i. f. (in this case 1.4 mc). The discriminator demodulates the second i-f signal and the a-f section of the receiver amplifies the audio output of the discriminator. The amplified output is supplied to headphones, loudspeaker, retransmission circuits, and to monitoring circuits (fig. 42).

a. Input Circuit. When the control relays are in the normal or unenergized position, the antenna is connected to the receiver circuits. Carrier signals from the antenna are developed in the antenna circuit, which is tuned by a section of the receiver-transmitter r-f tuning capacitor, C–1. The signals selected are applied to the r-f amplifier stage, V–1, the output of which is tuned by a section of the receiver-transmitter r-f tuning capacitor, C–1. The amplified output of this stage is routed to the receiver first mixer stage. When the SQUELCH control is turned clockwise from the OFF position, the gain of the r-f amplifier stage is controlled by the squelch circuit.

b. First Mixer Stage V–2. This stage combines the output of the harmonic amplifier, V–4, with the amplified output of the first r-f amplifier stage, V–1, to produce the first i. f. in the range of 4.45 to 5.45 mc. The frequency produced depends on the setting of the TENTH MCS control. The crystal oscillator-harmonic generator and first harmonic amplifier serve both the transmitter and the receiver. Since the output frequency of the first harmonic amplifier is below the frequency to which the receiver-transmitter is tuned (between 4.45 and 5.45 mc, depending on the setting of the tuning controls), the first i-f band resulting from the mixing of the incoming signal with the output of the frequency harmonic amplifier is a band centered about the difference frequency. The plate circuit of mixer stage V–2, located on the r-f chassis, is tuned by a section of the variable i-f tuning capacitor, C–101.

c. Amplification of First I-F Signal. The difference frequency band at the output of the mixer stage, V–2, is amplified in a two-stage, tuned, variable i-f amplifier, V–107 and V–108. The variable i-f amplifier stages are tuned by sections the of variable tuning capacitor, C–101.

d. Receiver-oscillator V–101. The free-running, self-excited oscillator, V–101, generates a frequency between 3.05 and 4.05 mc, depending on the setting of a section of the variable i-f tuning capacitor, C–101. The frequency to which the oscillator is tuned is always 1.4 mc below the frequency to which the variable i-f amplifier is tuned. Thus, if the variable i-f amplifier is tuned to 5 mc, the receiver-oscillator is tuned to 5 minus 1.4, or 3.6 mc.

e. Receiver Second Mixer V–109. The output of the variable i-f amplifier (a frequency

between 4.45 and 5.45 mc), together with the output of receiver oscillator V–101 is combined in the receiver second mixer, V–109. The frequency generated by the oscillator subtracts from the first (variable) i-f signals to produce a second i. f. of 1.4 mc.

f. Fixed Second I-F Amplifier and Limiter. The i. f. of 1.4 mc is amplified again by a three-stage fixed-tuned amplifier. The first stage, V–110, is a conventional i-f amplifier; the second and third stages, V–111 and V–112, are also designed to function as limiters to eliminate any amplitude variations of the signal. Such amplitude variations represent noise and are undesirable. Proper functioning of the discriminator, which follows the second limiter, requires that the level of the applied signal be fairly uniform for variations in the level of the incoming signal. A portion of the output of the first limiter is fed to the squelch circuit to provide silencing action.

g. Discriminator. The output of the final limiter stage, V–112, is applied to the discriminator and V–114. This discriminator is a tuned circuit which uses two type 1A3 diode tubes as rectifiers. The term "discriminator" is typical for f-m receivers and signifies a circuit which corresponds to the detector in a-m (amplitude-modulated) receivers. The discriminator performs a function analogous to that of the a-m detector since it extracts the intelligence or audio modulation from the incoming and carrier signal. Since in frequency modulation the intelligence to be *detected* appears as frequency variations (that is, shifts of the carrier from a center frequency) instead of amplitude variations, the discriminator is a frequency sensitive but not an amplitude sensitive device. Thus, the discriminator converts the variations from the center frequency of the incoming signal into audio signals.

h. Audio Amplification. The a-f signals which appear at the output of the discriminator are amplified in two separate audio amplifier circuits.

(1) One circuit is a two-stage audio amplifier, V–115 and V–116, with gain adjustable by means of the panel-mounted VOLUME control. The output of the first stage, V–115, is connected to pins A of each of the AUDIO connectors, and is used to provide enough volume to operate a headphone or the earpiece of a handset. The output of the final audio power amplifier stage, V–116, is connected to pins L of each of the AUDIO connectors and has sufficient output to drive a loudspeaker.

(2) The other circuit, a one-stage amplifier, V–102, serves to provide an audio output signal for monitoring (fig. 43). No panel adjustment of volume is provided. However, an internal potentiometer provides screw-driver adjustment of the gain of the amplifier to obtain the required level. The output of this stage is connected to pin B of the REC-TR CONTROL connector (J–312 in figure 42).

i. Squelch Oscillator V–103. A characteristic of very sensitive receivers is that in the absence of signals, a rushing noise is heard in the receiver phones or loudspeaker. The noise is the result of thermal agitation in the vacuum tubes and receiver components, and of external electrical disturbances. A *squelch* circuit is used to suppress this noise during no-signal intervals. In Set 1, the squelch circuit consists of a carrier-switched, 20-kc (approximately) oscillator and a diode rectifier, V–103. Squelch action is adjustable by means of the panel-mounted SQUELCH control. The squelch circuit can be disabled for test purposes or for reception of very weak or fading signals by turning the squelch control to the OFF position.

79. Interphone Amplifier

(fig. 45)

Figure 45 is a functional block diagram of AF Amplifier AM–65/GRC. The diagram shows the signal and power supply circuits which are provided by the amplifier.

a. General. The signal circuits consist of three input channels, a common amplifier, and three amplifying paths. In some systems the outputs of two receivers occupy two of the input channels, while the third or interphone channel will accept signals from a microphone. In the systems discussed in this manual only one receiver is used, therefore only two of the amplifier input channels are utilized. One channel contains the output of the Set 1 receiver, while the other contains the interphone output originating at any Control Box C–375/VRC which may be included with the radio set or the panel of the amplifier.

b. Common Channel Amplifier. Signals from Set 1 are routed to the common channel amplifier, which is divided into two sections. The signals are amplified there and appear across one section of the output. The other section ordinarily accom-

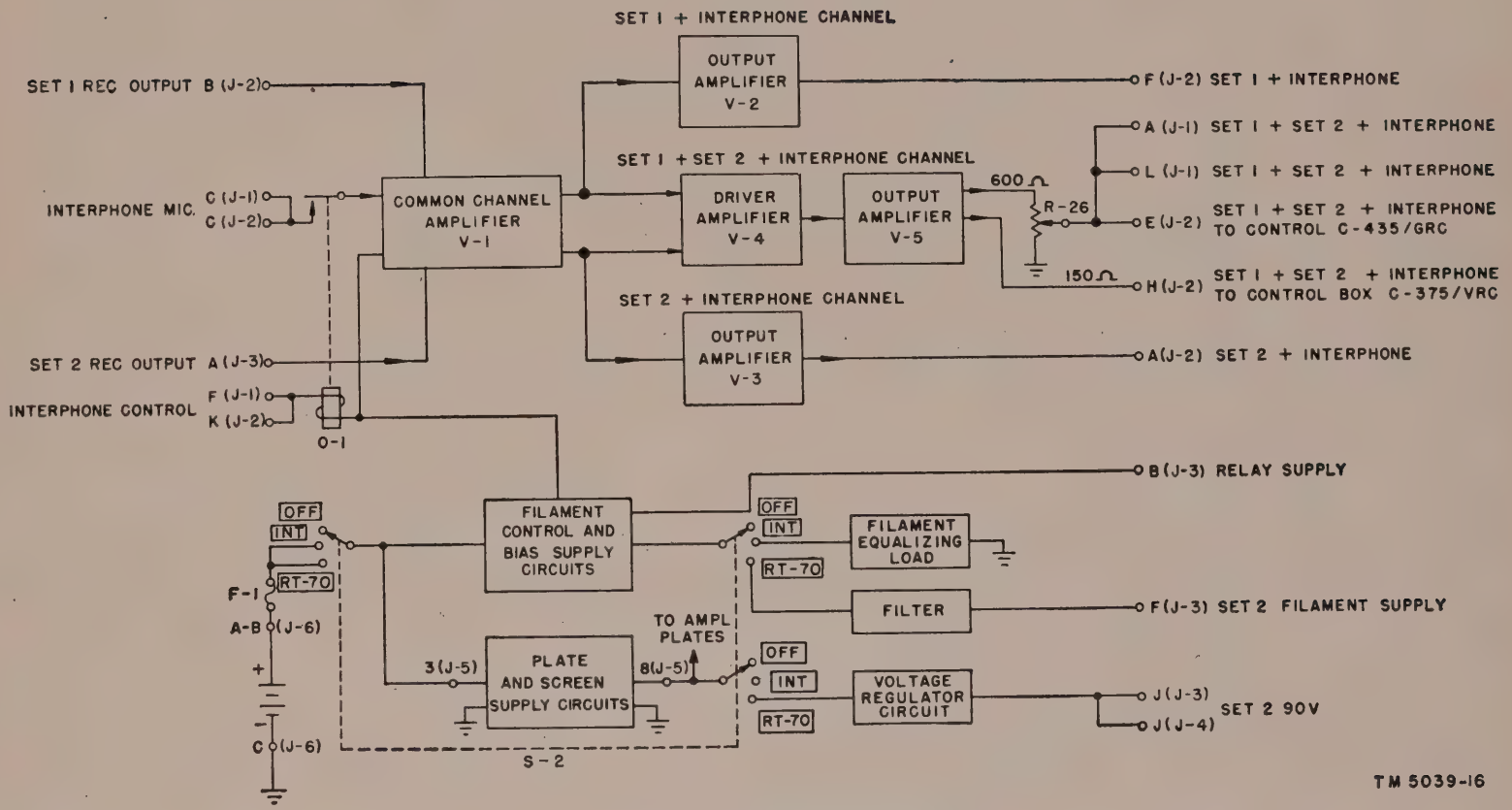


Figure 45. Interphone amplifier, block diagram.

modates signals from a Set 2 which is not used in this system. Signals from an interphone-connected microphone appear in push-pull across both sections of the common channel amplifier. They appear in the circuit when relay D/O–1 is energized. This relay is energized when an operator at one of the control boxes or the front panel of the amplifier presses the push-to-talk button on an interphone-connected microphone. Contacts of the relay close to complete the circuit to the external microphone and apply energizing potential to the microphone from the internal power supply circuits. Speech signals from the microphone enter the amplifier through the closed contacts of relay D/O–1, are amplified by V–1, and appear in the output circuits of that stage. An audio mixing arrangement in the common amplifier stage distributes the signals appearing at its output to the three output channels in use, as described in *c* below.

c. Signal Distribution. The Set 1 and interphone signals are applied at the required levels to Set 1 + Interphone and Set 1 + Set 2 + Interphone channels. Signals from Set 1 do not enter the third channel which is the Set 2 + Interphone channel. However, the microphone signal, appearing at the output of the common channel amplifier, is permitted to enter the Set 2 + Interphone channel, is amplified there, and is made available at the output terminals of that channel. The signals appearing at the output terminals of the three channels may be monitored at any one of the control stations associated with the installation. Switch R/S–1 in figure 42 illustrates how the channels are selected at a control box. Only the channel containing the Set 1 + Set 2 + Interphone signals may be monitored from the front panel of the amplifier.

d. Output Circuits. Signals passing through the Set 1 + Interphone channel are amplified in amplifier V–2 and appear at the output terminal for that channel. Similarly, signals passing through the Set 2 + Interphone channel are amplified in output amplifier V–3 and appear at the output terminals for that stage. Signals passing through the Set 1 + Set 2 + Interphone channel are amplified by driver amplifier V–4 and output amplifier V–5 and are applied through a VOLUME control to a 600-ohm output connector for application to Local Control C–434/GRC and to the AUDIO connector J–1 (fig. 42). These signals also are applied to a 150-ohm output connection for application to Control Box C–375/VRC (fig. 42).

e. Power Supply Circuits. The battery input is connected through a panel-mounted connector (J–6), through a fuse, and through contacts of the panel-mounted OFF-INT-RT-70 switch (S–2) to an h-v and an l-v supply circuit. The switch serves as the power on-off switch for the amplifier and for Receiver-Transmitter RT–70/GRC, when used. The h-v supply circuit includes a plug-in vibrator type power supply unit which converts the battery voltage into the required plate and screen voltages for the amplifier. The plate and screen voltages for the amplifier are taken directly from the output of the power supply unit. The l-v supply circuit provides the filament, relay, microphone, and bias voltages for the amplifier. The filament supply circuit includes contacts of switch S–2, in the RT–70 position, and an a-f filter. When Receiver-Transmitter RT–70/GRC is not used, as in this system, a filament equalizing load is substituted across the filament supply circuit by placing switch S–2 in the INT position. This prevents overloading the filament supply circuit.

CHAPTER 5
ORGANIZATIONAL MAINTENANCE

Section I. TROUBLE SHOOTING

80. Scope

Trouble shooting at an organizational level is limited to the sectionalizing of defective units which must be replaced as a unit, or to the localization of defective parts within the units for which running spares are available. An equipment performance checklist (par. 81) is included primarily as a sectionalization aid; localizing procedures for the various units are outlined in paragraphs 82 through 87.

81. Equipment Performance Checklist

a. PURPOSE. The equipment performance checklist provides a detailed logical procedure for checking the operation of the radio sets. It should be practiced after the initial installation of the equipment before the equipment is placed in service, periodically thereafter, and as an aid to trouble shooting.

b. USE OF CHECKLIST FOR TROUBLE SHOOTING.

(1) The checklist is arranged in the same sequence the operator would follow when initially applying power to the equipment. The simplest procedure, when using the checklist, is to perform the various items on the list in sequence until an abnormal indication is observed. When the operator has become familiar with the operation of the equipment, he can adapt the list to his own advantage, skipping those steps which do not pertain to the particular unit he wishes to check.

(2) The first five columns of the checklist list the items to be checked, the units which are involved, the action to take, and the normal indication to be expected. When an abnormal indication is obtained, the operator is referred (in the sixth column) to a paragraph or paragraphs which outline localizing procedures for particular units.

c. CHECKLIST. The items comprising the equipment performance checklist are listed in the following chart.

Item No.	Unit	Item	Action or condition	Normal indications	Possible defective units
1	Mounting	OFF-REMOTE-ON switch.	Set at OFF		
2		Cabling	All connections properly made (fig. 28).		
3	Local control unit	Installation	Unit plugged into mounting and locked.		
4	Local control	REMOTE switch	Set at TEL ONLY		
5	Interphone amplifier	OFF-INT-RT-70 switch	Set at OFF		
6	Interphone amplifier	VOLUME control	Turn to approximate midpoint of range.		
7	Set 1 power supply	OPERATE switch	Set at OFF		
8	Set 1 power supply	TRANS POWER switch.	Set at HIGH		
9	Set 1 receiver-transmitter.	SQUELCH control	Turn completely clockwise for maximum squelch operation.		
10	Set 1 receiver-transmitter.	RING-DIAL LIGHT (OFF-ON) switch.	Set at DIAL LIGHT ON		
11	Set 1 receiver-transmitter.	METER switch	Set at 90 V		
12	Interphone box	Chest set and head-set-microphone.	Connect chest set to audio connector; plug head-set-microphone into chest set.		

Item No.	Unit	Item	Action or condition	Normal indications	Possible defective units
13	Interphone box	RADIO TRANS switch	Lock in RADIO TRANS position.		
14	Interphone box	VOLUME control	Turn completely clockwise for maximum volume.		
15	Mounting	OFF-REMOTE-ON switch.	Turn to ON	POWER lamp glows if dimmer control is properly adjusted.	Battery, battery cable, or mounting (par. 84).
16	Interphone amplifier	OFF-INT-RT-70 switch.	Turn to INT position.		
17	Interphone box	Push-to-talk switch on chest set.	Press switch and talk into microphone.	Hear output in chest set	Interphone box (par. 84), mounting (par. 84), interphone amplifier (par. 85), or cables (par. 86).
18	Interphone box	Selector switch	Turn to Set 1 Interphone.		
19	Set 1 power supply	OPERATE switch	Turn to TRANS RECEIVE	LAMP on Set 1 panel glows. METER on Set 1 panel reads approximately center-scale (in shaded area).	Interphone box (par. 84), mounting (par. 84), Set 1 power supply (par. 83) or Set 1 (par. 83).
20	Set 1	METER switch	Turn successively to positions 7 through 11.	METER on Set 1 panel reads approximately center-scale.	Set 1 (par. 83).
21	Set 1	SQUELCH control	Turn counterclockwise. Adjust VOLUME control on interphone box for comfortable noise level.	Rushing noise (or signal) is heard in headset.	Interphone box (par. 84), mounting (par. 84), Set 1 (par. 83), or cables (par. 86). Also Set 1 fixed level VOLUME setting.
22	Set 1	Tuning control	Tune in signal (par. 57)	Signal heard in headset	Set 1 tuning circuit.
23	Set 1	SQUELCH control	Turn clockwise until receiver just squelches.	No signal heard in headset	Set 1 squelch circuit.
24	Chest set	RADIO and push-to-talk switches on chest set.	Press and hold for items 25 and 26.		
25	Set 1	METER switch	Turn successively to positions 2 through 6.	METER on Set 1 panel reads approximately center-scale.	Set 1 (par. 83).
26	Set 1	METER switch	Turn to RF position	Meter shows some deflection.	Set 1 (par. 83).
27	Set 1	DIAL LIGHT-OFF-ON-RING switch.	Hold at RING position for this item.	Ringing signal is heard in headset. Meter deflects.	Set 1 (par. 83).
28	Interphone box	Chest set and headset microphone.	Press switches and talk into microphone.	METER on Set 1 panel deflects and sidetone is heard in headset.	Audio accessory.
29	Chest set (with headset and microphone).	Connect in turn to each audio connector at each interphone box.	Repeat step 28	Output heard in headset. METER on Set 1 deflects.	Interphone box (par. 84) or cables (par. 86).
30	Mounting	POWER switch	Turn ot OFF		
31	Local control	LINE terminals	Connect to remote control unit (par. 37). Connect a chest set (with headset-microphone) to the local control unit; place REMOTE switch of local unit in TEL ONLY position. Connect a handset to the remote control unit; turn POWER switch on mounting to REMOTE.		
32	Local control unit	Ringing generator	Crank generator	Ringing signal should be heard or CALL light should glow at remote control unit.	Local control unit (par. 84), remote control unit (par. 84), or telephone line.
33	Remote control unit	SELECTOR switch	Turn to TEL Press push-to-talk switch on handset. Talk into mouthpiece and acknowledge call.	Full-duplex conversation possible between local and remote units.	Local or remote control unit (par. 84).
34	Remote control unit	Ringing generator	Crank generator	Ringing signal should be heard or CALL LIGHT should glow at local control unit.	Local or remote control unit (par. 84).
35	Local and remote control units.	Ringing generator	Repeat steps 32 and 34 with the internal CALL and RING switches set in their alternate position.	Ringing signals should be heard or CALL LIGHTS should glow.	Local or remote control unit (par. 84).
36	Local control unit	REMOTE switch	Turn to Sets 1 and 2	Panel lamp on mounting, Set 1, light.	Local control unit (par. 84).
37	Local control unit	LOCAL switch	Turn to Set 1. Press RADIO and push-to-talk switches. Talk into microphone. Release switch to TEL when finished.	Sidetone should be heard at chest set on interphone box.	Local control unit (par. 84) or mounting (par. 84).
38	Remote control unit	SELECTOR switch and handset.	Turn to left write-in position; press push-to-talk switch, and talk into mouthpiece.	Set 1 panel meter reads, sidetone heard at both chest sets.	Local or remote control unit (par. 84).

Item No.	Unit	Item	Action or condition	Normal indications	Possible defective units
39	Local control unit	REMOTE switch	Turn to Set 1 position	Panel lamps remain lighted since contacts 4–6 of N/O–3 were closed by step 38.	Local or remote control unit (par. 84).
40	Remote control unit	SELECTOR switch and handset.	Turn to left write-in position. Press push-to-talk switch.	POWER lamp on mounting glows. METER on Set 1 panel reads as long as push-to-talk switch is pressed.	Local or remote control unit or mounting (par. 84).
41	Remote control unit	SELECTOR switch and handset.	Turn to right write-in position. Press push-to-talk switch.	Power to Set 1 removed. Panel lamps extinguished.	
42	Local control unit	REMOTE switch	Turn to SET 2	No indication	
43	Remote control	SELECTOR switch	Turn to left write-in position. Press push-to-talk switch.	Panel lamps glow	Local and remote control units (par. 84).
44	Remote control unit	SELECTOR switch	Turn to right write-in position. Press push-to-talk switch.	Panel lamps extinguish	
45	Mounting	POWER switch	Turn to OFF		

82. Localizing Procedures

a. The following paragraphs include localizing procedures which are designed to isolate troubles to a particular unit, or to a particular part for which a running spare is available. These are the paragraphs which are referred to in the equipment perfomance checklist (par. 81); they are used best in conjunction with the checklist but can be used individually.

b. Whenever the procedure calls for checking a part, substitute an identical part which is known to be good for the part being checked. If no part is available for such use, a visual and/or continuity check may disclose the troubles.

83. Set 1 and Set 1 Power Supply

a. Equipment Set-up. Operational checks of Set 1 and the Set 1 power supply are best performed at the panels of the units themselves. Set up the equipment as follows:

(1) Turn the OPERATE switch to TRANS & RECEIVE.

(2) With the mounting switch in the OFF position, disconnect the REC-TR-CONTROL cable from the panel of Set 1. Connect terminals H and J of the receptacle, using the prefabricated plug-in jumper provided with the Allen wrenches within Set 1. Turn the mounting switch to the ON position (The jumper makes Set 1 independent of interconnections normally made through the mounting). When all checks have been completed, remove the jumper and replace the cable.

(3) Connect a handset to one of the AUDIO connectors on the Set 1 panel.

b. Lamp Check. If the dial LAMP on Set 1 does not light, with the RING-DIAL LIGHT (OFF-ON) switch in the ON position, turn the METER switch to position 7 and interpret the meter indications as follows:

(1) If the meter reading is normal or slightly higher than normal, the lamp is probably bad.

(2) If the meter reading is higher than normal, check tubes V–113, V–3, and the lamp (fig. 54 and par. 87).

(3) If the meter reading is zero, turn the METER switch to position 9. If the reading is normal at position 9, check tubes V–116 of Set 1 (fig. 53 and par. 87). If the tubes checked are good and reading is very low or zero, the trouble is probably in the power supply. Check fuse F–1, continuity of thermal relay K–2, and ballast tubes R–31 and R–40 in the power supply (figs. 49 and 50 and par. 91). (Ballast tube R–40 is included only in Power Supply PP–112/GR.)

c. Voltage Check. Turn the METER switch to the 90V position and check for a normal reading. If no reading is obtained, make the following checks:

(1) Check fuse F–2 in the power supply (par. 91).

(2) If the fuse is good, check vibrator E–3 and voltage regulator V–4 (fig. 49 and par. 91).

(3) If the above checks do not reveal a defective part, refer to paragraph 86 for additional check procedures.

d. Receiver Filament Check. Turn the METER switch successively through positions 7, 8, 9, 10, and 11. If an abnormal meter reading is obtained in any of these positions, refer to the filament chart (par. 87) for the probable defective tube involved. Refer also to the filament schematic (fig. 46).

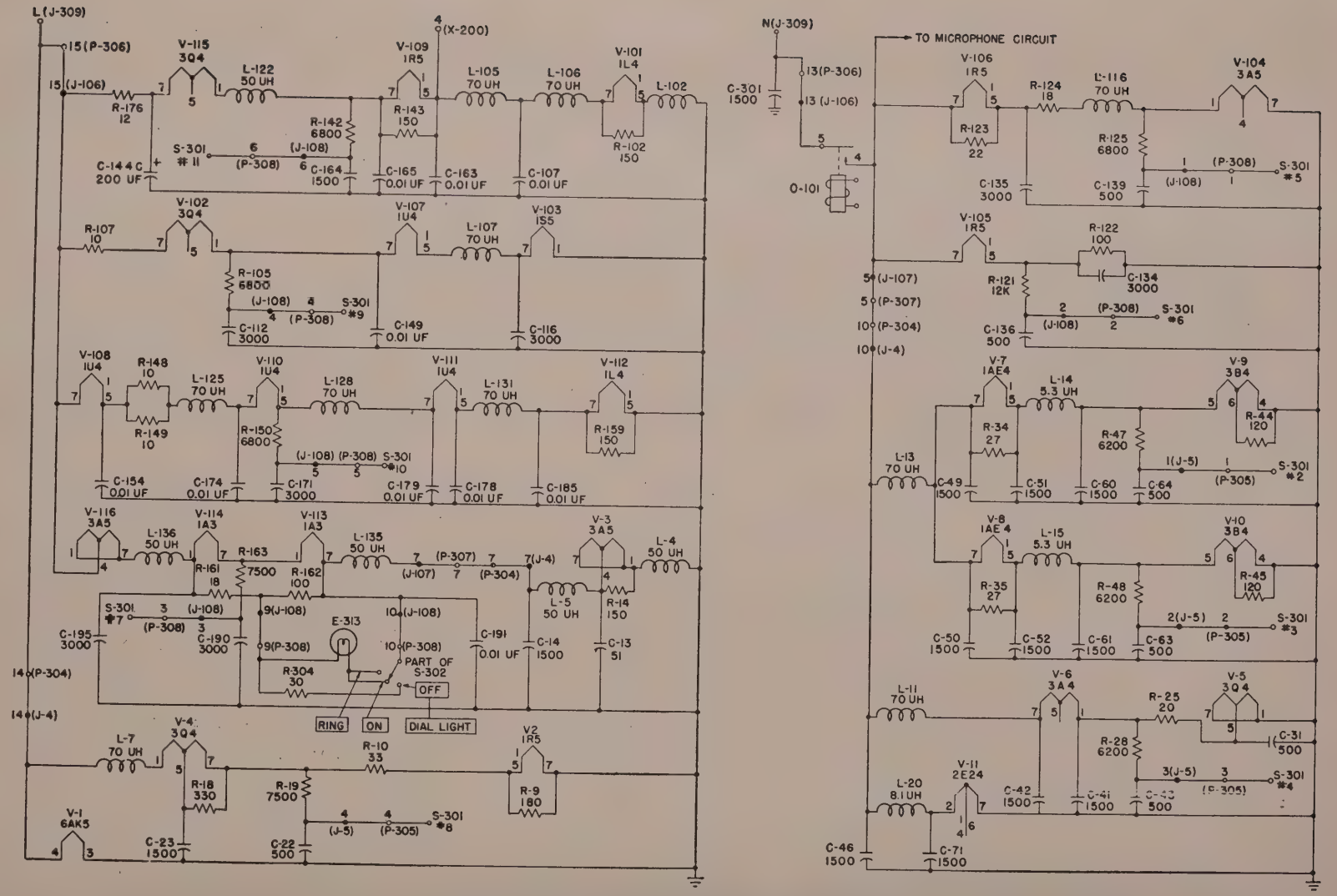


Figure 46. Set 1 filament circuit, schematic diagram.

e. Receiver Check. Turn the SQUELCH control counterclockwise and check for noise output in the earpiece of the handset. If no noise is heard, check tubes V–2 and V–107 through V–116 for filament continuity (par. 87). If the filaments are good, replace the tubes one at a time with identical type tubes which are known to be good until the defective tube is isolated.

f. Transmitter Filament Check. Press the push-to-talk button on the handset and turn the METER switch successively through positions 2, 3, 4, 5, and 6. If an abnormal meter reading is obtained, refer to the filament chart (par. 87) for the probable defective tube involved. Refer also to the filament schematic (fig. 46). If all of the readings are very low or zero, the trouble is probably in the power supply (par. 91). Check fuse F–1, thermal relay K–1, and ballast tubes R–24, R–25, R–37, and R–38 in the power supply (figs. 49 and 50). (Ballast tubes R–37 and R–38 are included in Power Supply PP–112/GR only.)

g. Transmitter Output Check. Turn the METER switch to the RF position, press the push-to-talk switch on the handset, and talk into the mouthpiece. Interpret the indications as outlined below.

(1) If an abnormally low deflection is obtained on the meter, check the antenna tuning (par. 35). If it is impossible to obtain any output, and the tubes have been checked as outlined in the preceding subparagraphs, the trouble may be due to misalinement.

(2) If r-f output is obtained, sidetone should be audible in the earpiece. If no sidetone is heard, check tubes in the receiver section of Set 1 (figs. 53 and 54). Also check modulator tube V–105, 106 and oscillator tube V–104.

h. Ringing Check. Turn the RING-DIAL LIGHT (OFF-ON) switch to the RING position and check for r-f output on the meter and a ringing signal in the earpiece. If abnormal indications are obtained, check tube V–104 in Set 1 (fig. 54 and par. 92).

84. Miscellaneous Components

The mounting, retransmission unit, interphone boxes, local control unit, and remote control unit may prove defective with regard to lamp, switch, and relay operation. General trouble-shooting techniques are outlined below. Refer to figure 21 as an aid.

a. Mounting. If the mounting lamp lights, power should be available to all units. If the lamp is lit but all units do not have power, the trouble is probably caused by faulty wiring in the mounting. If the lamp is not lit but power is available to at least one unit, either the lamp is defective or the dimmer control is incorrectly adjusted. Continuity checks of the mounting should reveal any troubles which may arise within the mounting. A schematic diagram of the mounting is shown in figure 74. Before making continuity checks, check all fuses in individual units.

b. Interphone Box.

(1) When normal indications are obtained at a panel AUDIO connector but not at an interphone box, the trouble must be in the cable interconnections or the interphone box.

(2) If none of the interphone boxes is operative for a particular function, the trouble is in either the mounting-interphone box, interconnecting cable, or in the internal wiring within the rack-mounted unit which is being checked.

(3) If any one interphone box is operative and others are inoperative, the trouble is probably in the cables which are used to connect the interphone boxes in parallel.

(4) If trouble is isolated to a particular interphone box, continuity checks on the box should reveal the defect. The following chart lists the measurements which should be taken to check the continuity of all parts and wiring within the interphone box. A schematic diagram is shown in figure 72.

Points of measurement	Position of RADIO TRANS switch S–2	Position of selector switch S–1	Resistance reading
Terminal 1 of E–2 to tips of jacks J–3 and J–4 and to F contact of connectors J–1 and J–2.	Center		Infinity.
	RADIO TRANS	Counterclockwise	0.
		Center	Infinity.
		Clockwise	Infinity.

Points of measurement	Position of RADIO TRANS switch S–2	Position of selector switch S–1	Resistance reading
Terminal 2 of E–2 to J contact of connectors J–1 and J–2.	----------	----------	0.
Terminal 2 of E–2 to tips of jacks J–3 and J–4 and to F contacts of connectors J–1 and J–2.	Center	----------	0.
	RADIO TRANS	Counterclockwise	Infinity.
		Center	0.
		Clockwise	Infinity.
Terminal 3 of E–2 to tips of jacks J–3 and J–4 and to F contacts of connectors J–1 and J–2.	Center	----------	Infinity.
	RADIO TRANS	Counterclockwise	Infinity.
		Center	Infinity.
		Clockwise	0.
Terminal 4 of E–2 to B, E, and H contacts of connectors J–1 and J–2.	----------	----------	0.
Terminal 5 of E–2 to rings of jacks J–3 and J–4 and to C contacts of connectors J–1 and J–2.	Center	----------	Infinity.
	RADIO TRANS	Counterclockwise	0.
		Center	Infinity.
		Clockwise	Infinity.
Terminal 6 of E–2 to K contacts of contors J–1 and J–2.	----------	----------	0.
Terminal 6 of E–2 to rings of jacks J–3 and J–4 and to C contacts of connectors J–1 and J–2.	Center	----------	0.
	RADIO TRANS	Counterclockwise	Infinity.
		Center	0.
		Clockwise	Infinity.
Terminal 7 of E–2 to rings of jacks J–3 and J–4 and to C contacts of connectors J–1 and J–2.	Center	----------	Infinity.
	RADIO TRANS	Counterclockwise	Infinity.
		Center	Infinity.
		Clockwise	0.
Terminal 8 of E–2 to tips of jacks J–5 and J–6 and to A contacts of connectors J–1 and J–2.	----------	Counterclockwise	0 to 10k depending on position of VOLUME controls R–1 and R–2.
Terminal 9 of E–2 to tips of jacks J–5 and J–6 and A contacts of connectors J–1 and J–2.	----------	Center	0 to 10k depending on position of VOLUME controls R–1 and R–2.
Terminal 10 of E–2 to tips of jacks J–5 and J–6 and to A contacts of connectors J–1 and J–2.	----------	Clockwise	0 to 10k depending on position of VOLUME controls R–1 and R–2.
Terminals 11 and 12 of E–2 to chassis	----------	----------	Infinity.
Terminal 13 of E–2 to terminals 14 and 15 of E–2.	----------	----------	0.

c. Local and Remote Control Units. To check operation of the local and remote control units, perform the applicable items of the equipment performance checklist (par. 81) and check for normal indications as listed. If abnormal indications are obtained, refer to the schematic diagrams (figs. 72 and 73) and make continuity checks of the units.

85. Interphone Amplifier and Power Supply

Warning: Never turn the OFF-INT-RT-70 switch on the amplifier front panel to the RT–70 position, unless a suitable load is substituted for the Receiver-Transmitter RT–70/GRC, or the receiver-transmitter is used across the output terminals which supply power to this unit. Without the proper loading, thermal relay K–1 in the amplifier unit will be severely overloaded.

a. Equipment Set-up. Operational checks of the interphone amplifier and its power supply may best be performed from the interphone box in conjunction with the front panel of the amplifier. To make these checks, it is necessary that the equipment be set up in the following manner:

(1) Turn the mounting switch to the OFF position.

(2) Turn the OFF-INT-RT–70 switch, on the amplifier panel, to the INT position.

(3) Turn the VOLUME controls on the amplifier front panel and on the interphone box to their respective half-volume points.

(4) Turn the RADIO TRANS switch to the center position, on the interphone box.
(5) Connect a chest set group (including a headset and microphone), known to be good, to the AUDIO connector on the front panel of the amplifier.
(6) Connect a chest set group (including a headset and microphone), known to be good, to an audio connector on the interphone box.
(7) Turn the selector switch on the interphone to the SET 1+INT position.
(8) Turn the mounting switch to the ON position.

b. Normal Indications. The following procedural checks indicate what should be expected from the amplifier and its power supply under normal operating conditions.

(1) Using the chest set group connected to the interphone box, operate the switches and talk into the microphone. Note the volume of the voice signal that is heard in the headset.
(2) Turn the selector switch on the interphone box to the center position, marked INT, and repeat step (1) above.
(3) Turn the selector switch on the interphone box to the extreme clockwise position, unmarked, and repeat (1) above.
(4) The volume of the voice signal that is heard when the selector switch is in the INT position should be louder than that which is heard in either of the other two positions of the selector switch. All three volumes should be fully perceptible.

c. Abnormal Indications. When the procedures which are outlined in *a* and *b* above have been performed and indications other than those noted occur, an abnormality or trouble exists somewhere within the system. The particular trouble that would be present is confined to one or more of the following units: the interphone box, the mounting, the interphone amplifier, the amplifier power supply, and the interconnecting cables. To determine which unit is faulty and what might be at fault within the unit, read through the following steps and perform those which are applicable.

(1) When no output is obtained with the selector switch in any of its three positions, operate the chest set that is connected to the panel of the amplifier and listen for a voice signal in the headset. If a voice signal is heard, check all cables for proper connections and check the wiring in the mounting and interphone box for continuity (pars. 84 and 86.) If no signal is heard at the panel, check V–1, thermal relay K–1, and ballast resistor R–32 in the amplifier (par. 85 and fig. 47). Should these components fail to disclose the trouble, check vibrator E–1 in the amplifier power supply (par. 85 and fig. 48).
(2) When no output is obtained with the selector switch in the INT position, but outputs are noted in the other two positions of the selector switch, operate the chest set at the panel of the amplifier. Listen for a voice signal in the headset. The presence of a signal at this point indicates a fault in the interconnecting cables (par. 86), or in the wiring of either the mounting or the interphone box (par. 84). Should no signal be present at the panel of the amplifier, check amplifier tubes V–4 and V–5.
(3) When no output is obtained with the selector switch in the first position (SET 1+INT), or in the third position, but is heard in the center position, check V–2 and V–3 in the amplifier, respectively. Should these checks fail to reveal the fault, refer to paragraphs 84 and 86.

86. Cables

When normal indications are obtained at a panel AUDIO connector but not at an interphone box, the trouble may be caused by a poor cable connection or an open lead within a cable. Continuity checks must be made to determine such faults. In some instances the cables are terminated by solder connections on a terminal board within the mounting, an interphone box, or intermediate junction boxes. To obtain access to these points it will be necessary to open the unit involved. Figures 19 and 28 show an open view of the mounting and the system cordage diagram, respectively. The interior of the interphone box is shown in figure 22. The above mentioned illustrations and the unit schematic diagrams should be used when making continuity checks.

87. Set 1 Filament-Circuit Trouble Localization Chart

The following chart lists the Set 1 tubes checked for each position of the METER switch on the Set 1 panel. A center-scale reading is the normal reading for all positions of the switch. If the normal reading is not obtained, the probable defective tube is listed under the type of reading which is obtained. To obtain a reading in positions 2 through 6 of the METER switch, the push-to-talk button must be pressed. Observe the notes at the end of the chart.

METER switch position	Zero reading	Too low but not zero reading	Too high but not full-scale reading	Full-scale reading
2	V–7	V–7	V–9	V–9.
3	V–8	V–8	V–10	V–10.
4	V–6			V–5.
5	V–106	V–106		V–104.
6	V–105			
7	V–116, V–114		V–113, V–3	V–3.
8	V–4		V–2	V–2.
9	V–102			V–107, V–103.
10	V–108, V–110		V–112	V–111, V–112.
11	V–115		V–109, V–101	V–109, V–101

Note 1. The transmitter power amplifier tube, V–11, and the receiver first r-f amplifier tube, V–1, are not checked by the METER switch. These tubes must be checked by visual inspection. Observe whether (with power applied) the tube filaments are lit. The filament of V–11 is energized when the microphone push-to-talk button is operated.

Note 2. Because of the series-parallel arrangement of the tube filaments, a break in the filament of one tube in a series string of tubes will cause all the other tubes in the string to go out and will produce indications of a faulty stage involving those tubes.

Note 3. A high reading for all filaments on positions 7 through 11 may be due to a faulty V–1. A high reading on positions 2 through 6 may be due to a faulty V–11. A low voltage for all tubes may be due to the operation of the overload relay in the power supply or trouble in the power supply.

Note 4. Turn off all power when replacing tubes.

Section II. REPLACEMENT OF PARTS

88. General

The following paragraphs list procedures for the replacement of parts for which running spares are provided. The running spares for each unit are listed in paragraph 19. The procedures described will be necessary as a result of sectionalizing a trouble to a particular unit and as an aid to localizing the trouble within the unit to a particular component part.

Note. Since no lubrication is required for Radio Sets AN/VRC–13, –14, and –15, there is no disassembly procedure to be followed concerning lubrication.

89. Removing Immersionproof Cases

Replacement of pluck-out parts (with the exception of fuses) necessitates the removal of the immersionproof cases which house the panel-chassis assemblies of the various units. To remove the case of Set 1, the Set 1 power supply, or the interphone amplifier, perform the following steps.

a. Remove all external connections from the unit involved.

b. Remove the unit from the mounting.

c. Loosen the DZUS fasteners located at the edges of the unit.

d. Slide the panel-chassis assembly out of the case. Take care not to damage any wiring or components while removing and handling the panel-chassis assembly.

90. Interphone Amplifier

The replacement of pluck-out parts for which spares are available is described below.

a. Fuse. The panel-mounted fuse may be removed by unscrewing the fuse cap which also serves as a fuse extractor. A spare fuse is located in a fuse clip on the amplifier chassis (fig. 47).

b. Thermal Relay and Ballast Tube. Thermal relay K–1 and ballast tube R–32 are mounted in a horizontal position at the rear of the amplifier chassis (fig. 47). After removing the panel-chassis assembly from the case, remove the relay or ballast tube with a straight horizontal pull. Do not rock or jiggle the component in its socket; the socket prongs may be damaged.

c. Tubes. All tubes are accessible from the top of the chassis when the case has been removed

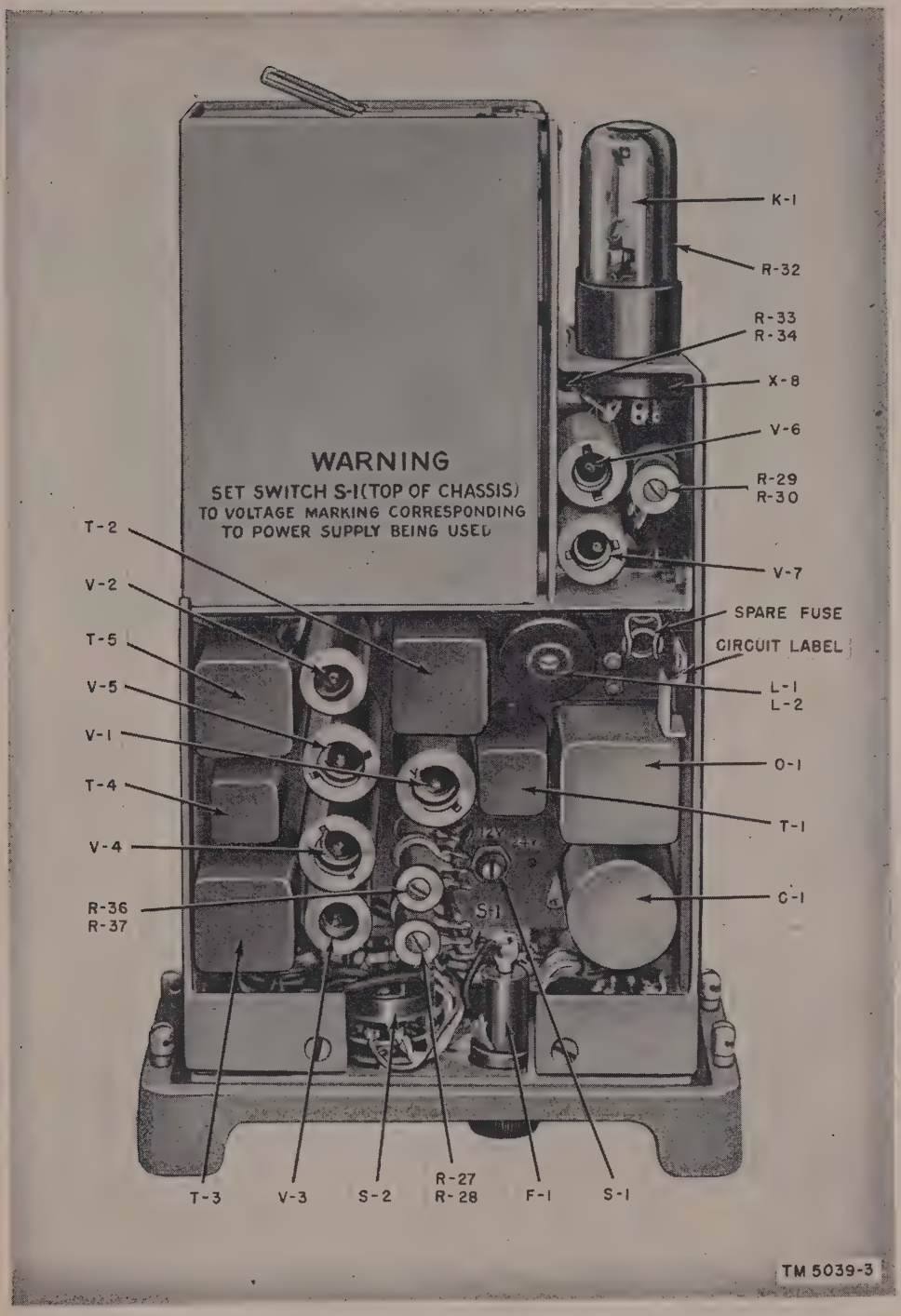


Figure 47. AF Amplifier AM–65/GRC, top view of chassis.

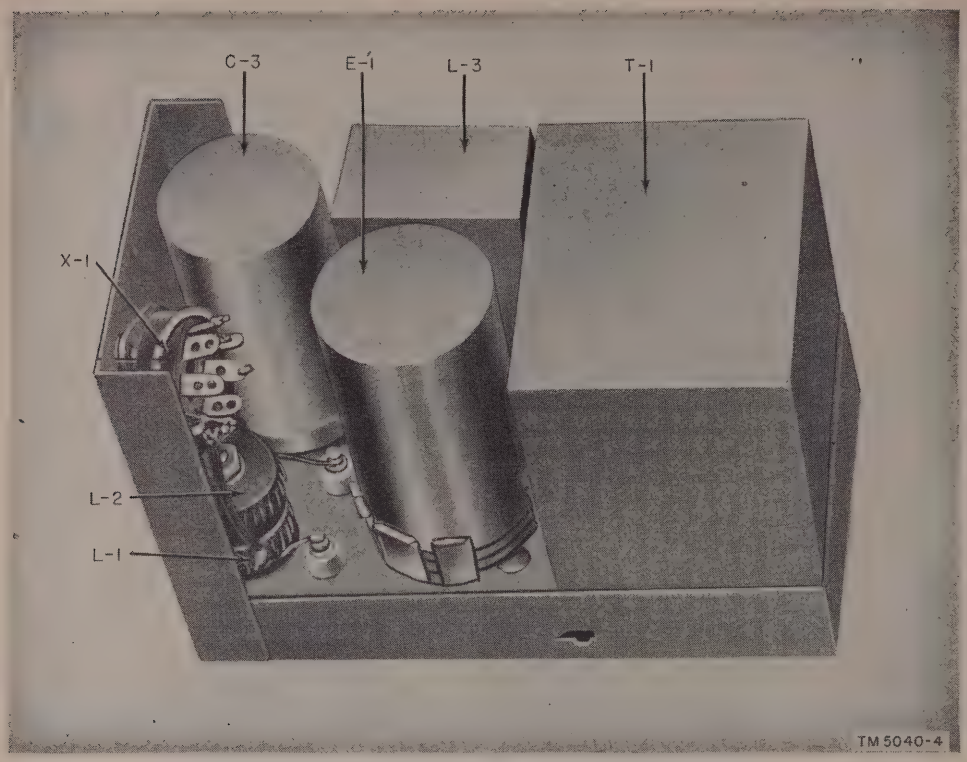


Figure 48. Power Supply PP–282/GRC, top view of chassis.

(fig. 47). To remove any tube, first remove the tube shield and then use a tube puller. Do not rock or jiggle a tube in its socket; the tubes are easily damaged by careless handling.

d. Plug-in Power Supply. Although it can be replaced as a single unit, the plug-in power supply is not furnished as a running spare. However, a spare is provided for the vibrator within the power supply (fig. 48). Remove the amplifier case and replace the vibrator as follows:

(1) Loosen the clamp at the rear of the power supply compartment and swing it out of the way.
(2) Grasp the handle at the rear of the power supply unit and pull straight out.
(3) Remove the three green screws which fasten the top cover on the power supply chassis.
(4) Using the handle on the cover, lift the cover off with a straight upward movement. If the cover is stuck, use a small screw driver and gently pry the cover.
(5) Pull the vibrator (fig. 48) out of its socket with a straight upward movement. Do not rock or jiggle the vibrator while attempting to remove it from its socket. If necessary, use a small screw driver to gently pry the vibrator out of its socket, but take care not to enlarge the ring clip which holds the vibrator near the base.

91. Set 1 Power Supply

The replacement of pluck-out parts for which spares are available is described below.

a. Fuses. The panel-mounted fuses may be removed by unscrewing the fuse caps which serve also as fuse extractors. Spare fuses are provided in the front-panel compartment marked SPARE FUSES. To gain access to the spares, loosen the two wingnuts which hold the cover plate of the compartment and remove the plate.

b. Thermal Relays and Ballast Tubes. To gain access to the thermal relays and ballast tubes, it is necessary to remove the panel-chassis assembly from the case (par. 89). All of these parts are accessible from the top of the chassis (figs. 49 and 50). Remove the relays or ballast tubes in the same manner as any standard octal-base tube; with a straight upward pull. Do not rock or jiggle the components in their sockets (note that similarly designated parts are located differently in the 12- and 24-volt supplies).

c. Tubes. The four-power supply tubes are also accessible from the top of the chassis. To

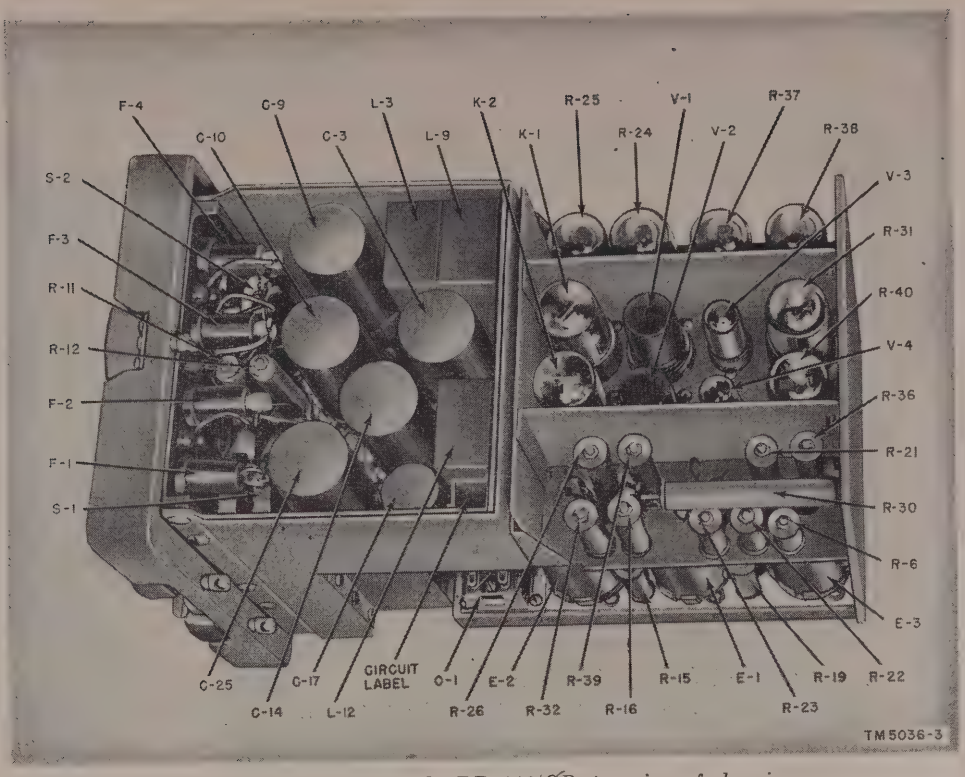


Figure 49. Power Supply PP–112/GR, top view of chassis.

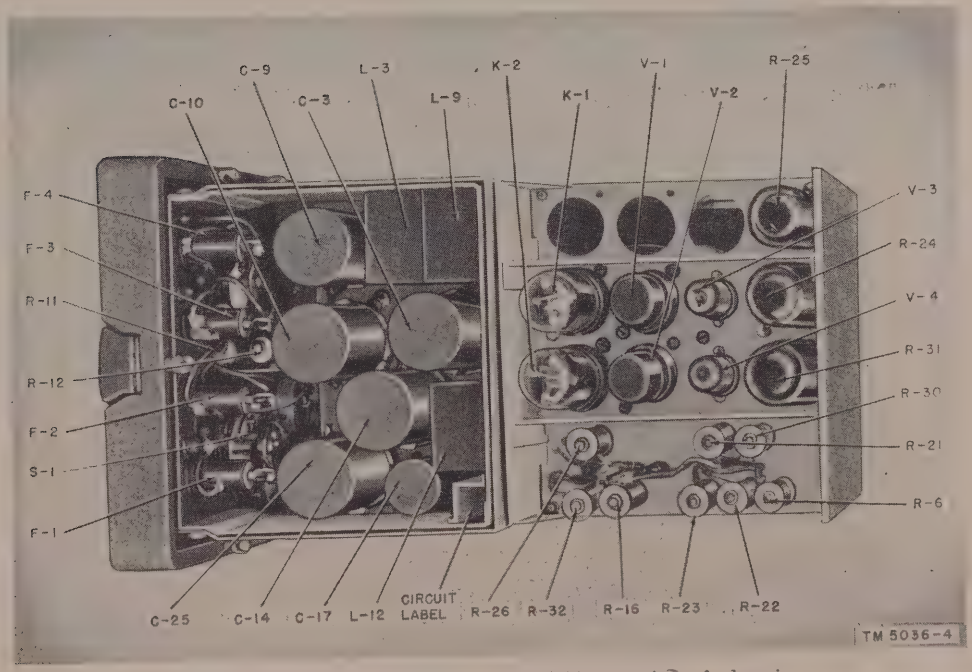


Figure 50. Power Supply PP–109/GR, top view of chassis

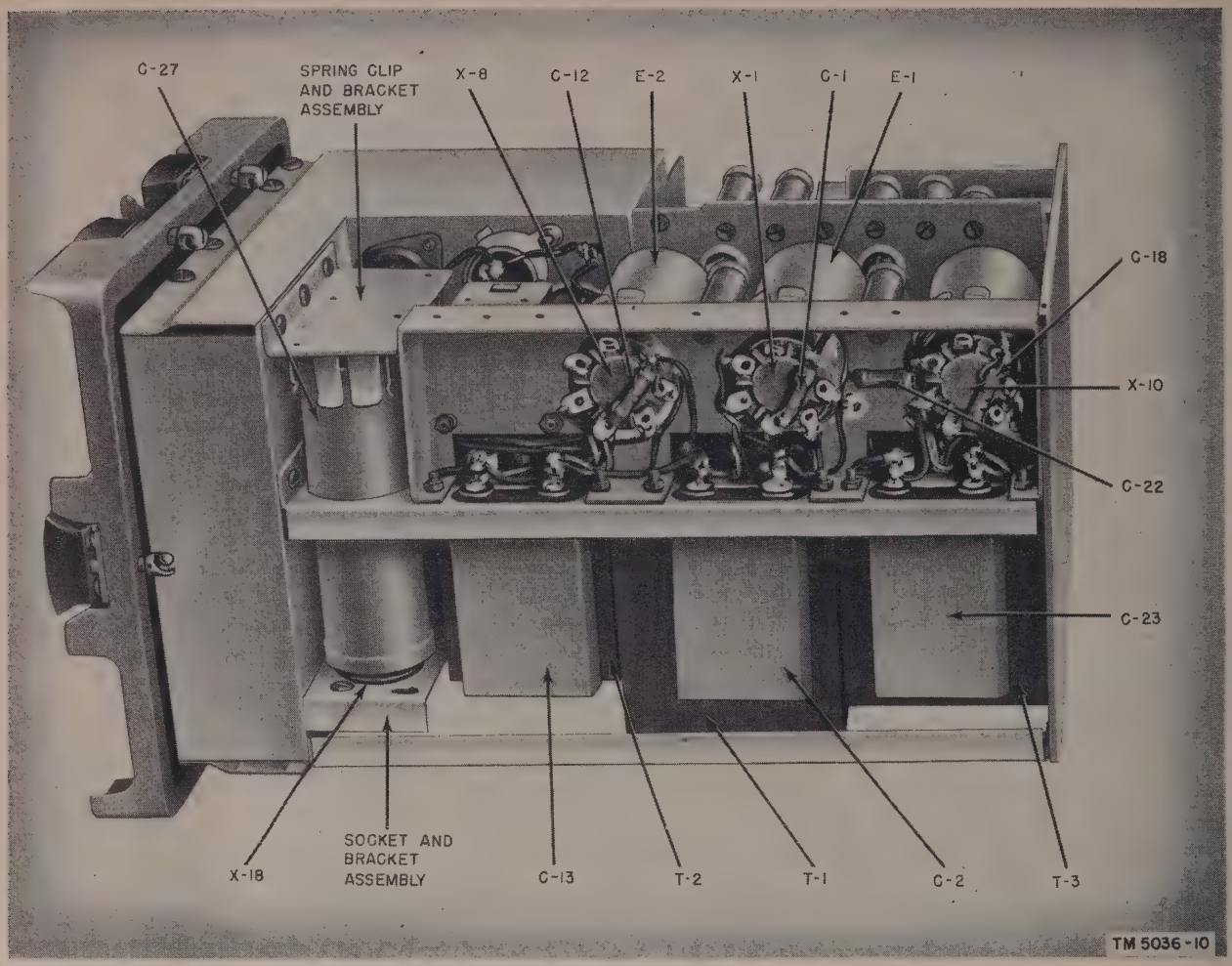


Figure 51. Power Supply PP–109/GR, bottom view of chassis.

remove V–1 or V–2, pull the tube straight upward. To remove V–3 or V–4, use a tube puller. Do not rock or jiggle the tubes in their sockets; the socket prongs and tubes may be damaged.

d. Vibrators. The three vibrators (E–1, E–2, and E–3) are located on the right-hand side of the power supply chassis (fig. 51). To remove a vibrator, pull straight upward without jiggling. If necessary, use a small screw driver to pry the vibrator out of its socket but take care not to spread the ring clip at the base of the vibrator.

92. Set 1

The tubes, which are the only replaceable parts in Set 1, are mounted on the vertical r-f and i-f chassis (fig. 52). To gain access to the tubes, the panel-chassis assembly must be removed from its case (par. 89).

a. Tubes V–1 through V–11 are mounted on the r-f chassis (fig. 53). Tubes V–101 through V–116 are mounted on the i-f chassis (fig. 54). With the exception of V–11, each of these tubes may be removed with a tube puller after the shield is removed.

b. Before removing V–11 it is necessary to disconnect the plate cap at the top of the tube. When the cap is disconnected, the tube can be removed with a straight upward pull. Do not rock or jiggle the tube in its socket; the sockets and tubes may be damaged through careless handling.

93. Control Group AN/GRA–6

The lamps are the only pluck-out parts in either local or remote control unit for which running spares are supplied. The lamps are accessible from the rear of the front panels after the panel-chassis assemblies have been removed from the cases (figs. 32 and 33).

a. To gain access to the lamp in the local control unit, unscrew the two wingnut fasteners at the

edge of the front panel and slide the unit out of its case. Slide the lamp socket (with lamp) out of the bakelite sleeve. The lamp may then be replaced.

b. To gain access to the lamp in the remote control unit, loosen the spring clips which secure the panel-chassis assembly in the case. Slide the unit out of its case and replace the lamp as directed for the local unit (*a* above).

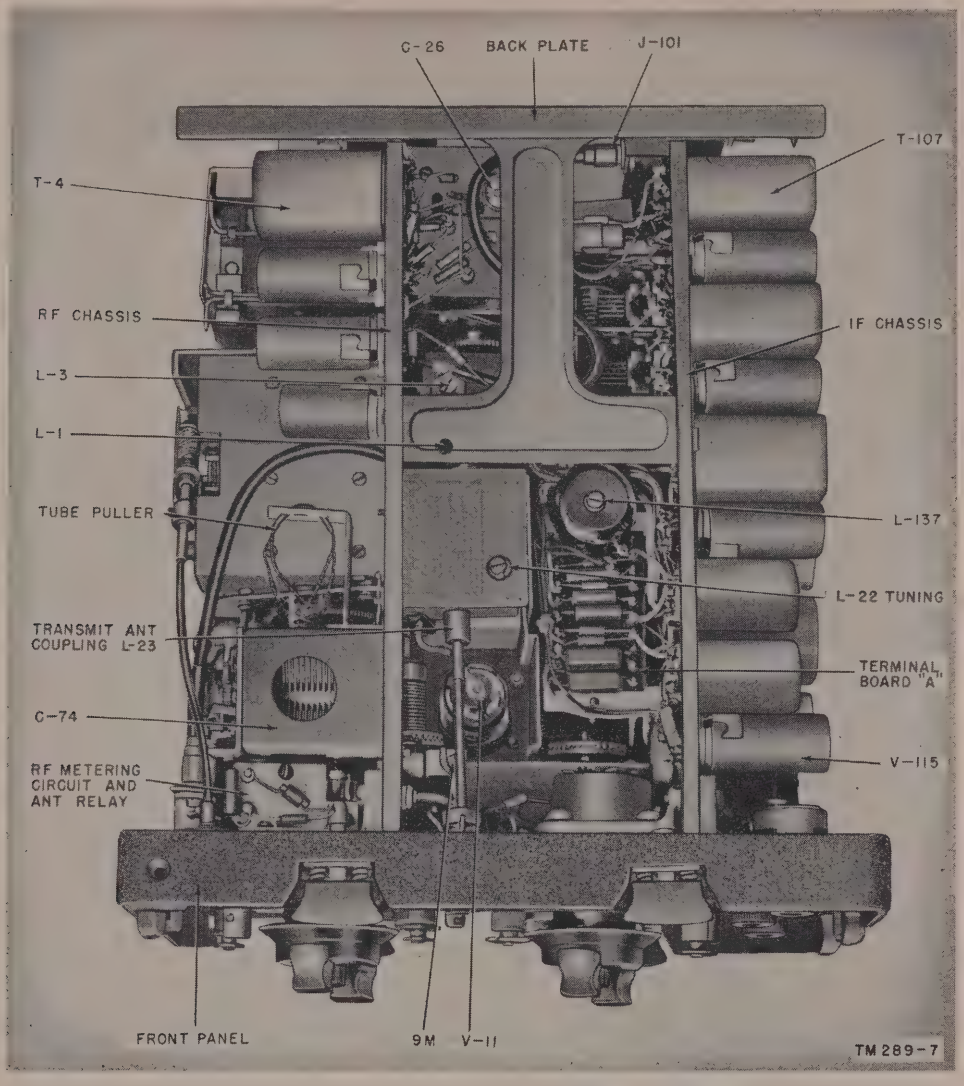


Figure 52. Set 1, top view of panel-chassis assembly.

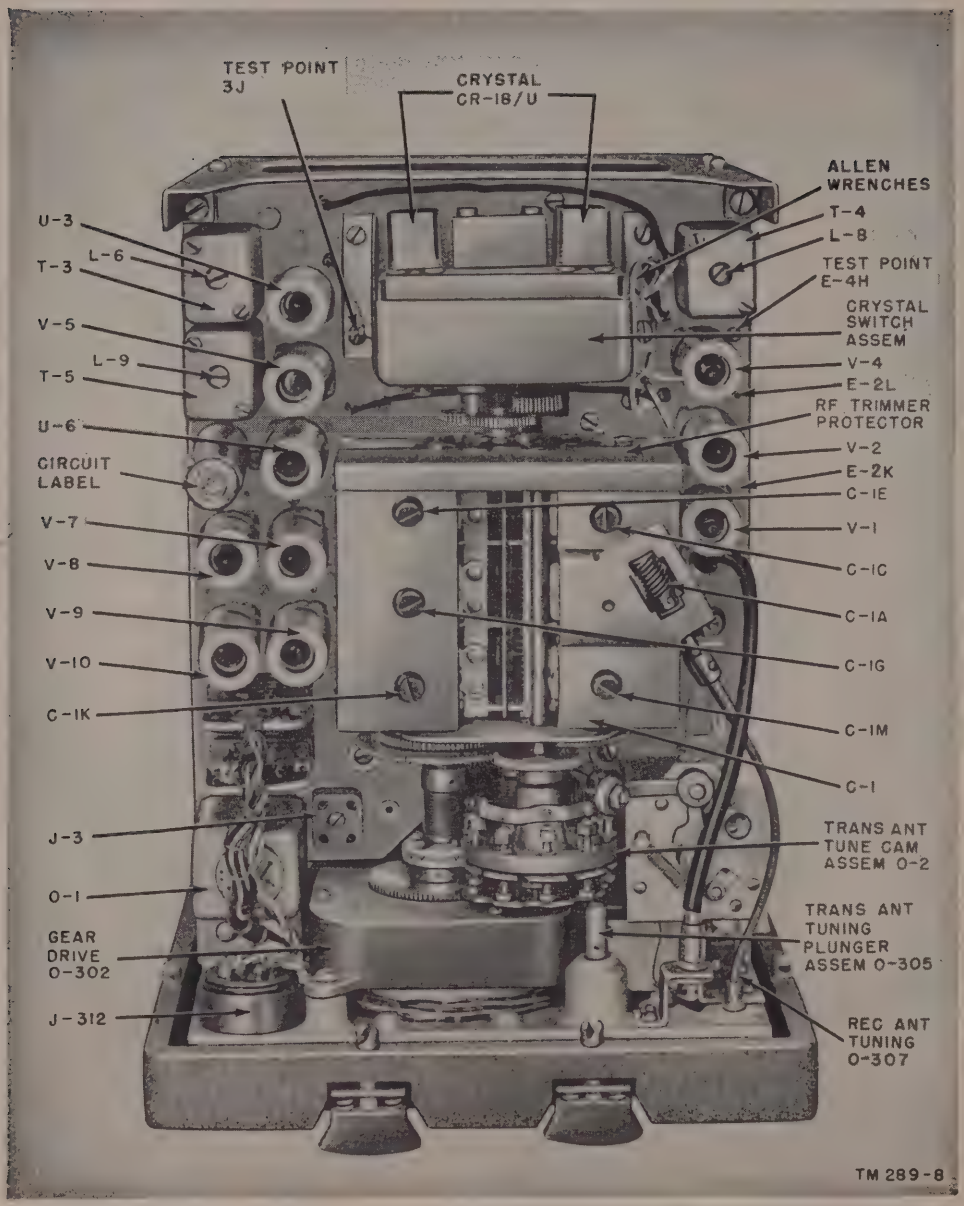


Figure 53. Set 1, view of r-f chassis.

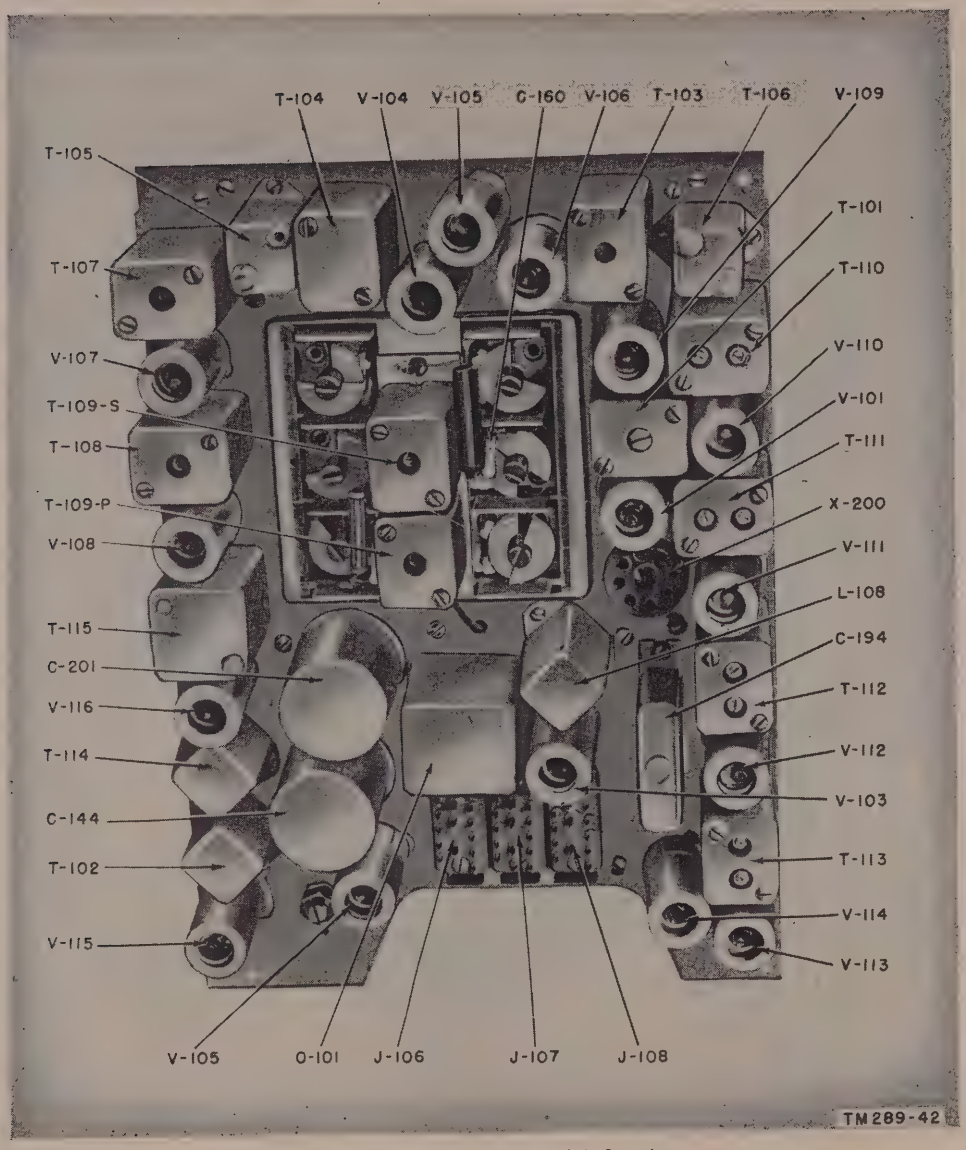


Figure 54. Set 1, view of i-f chassis.

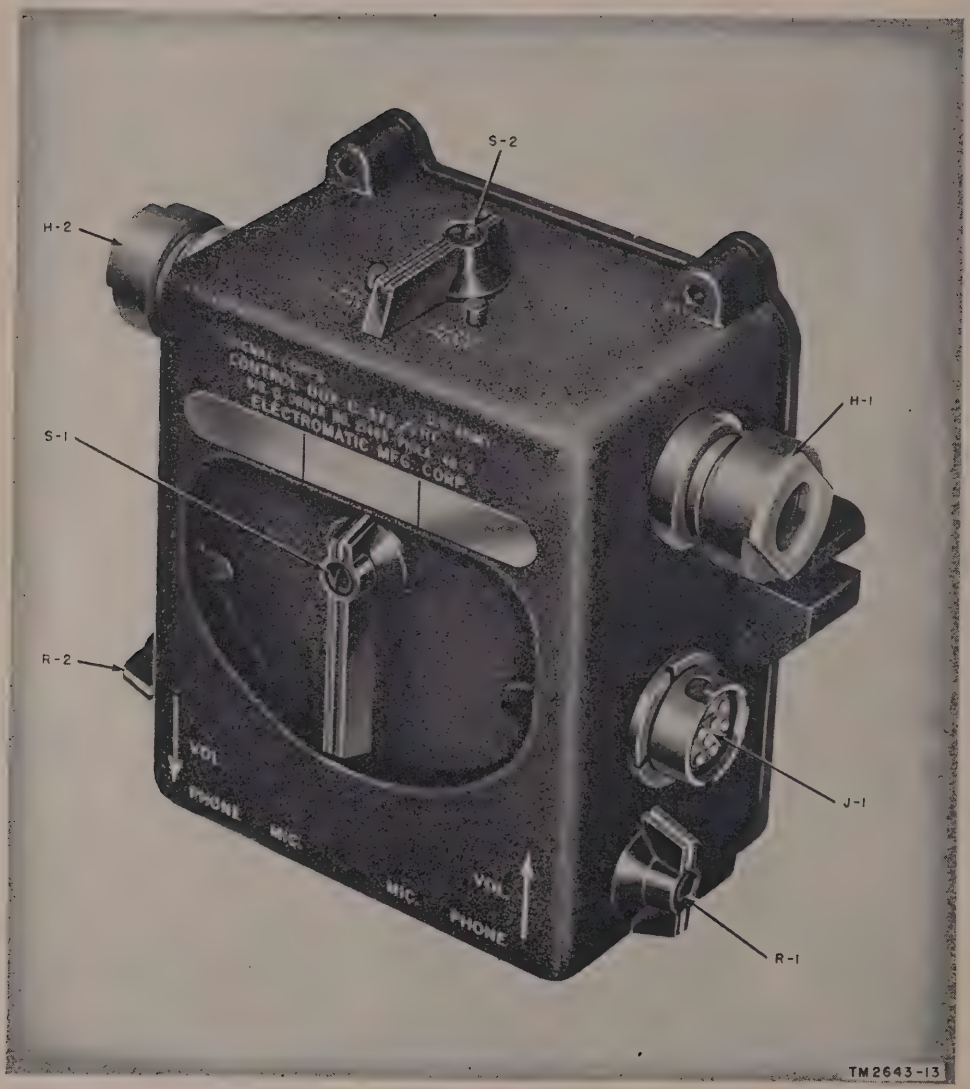


Figure 55. Control Box C-375/VRC, right oblique view.

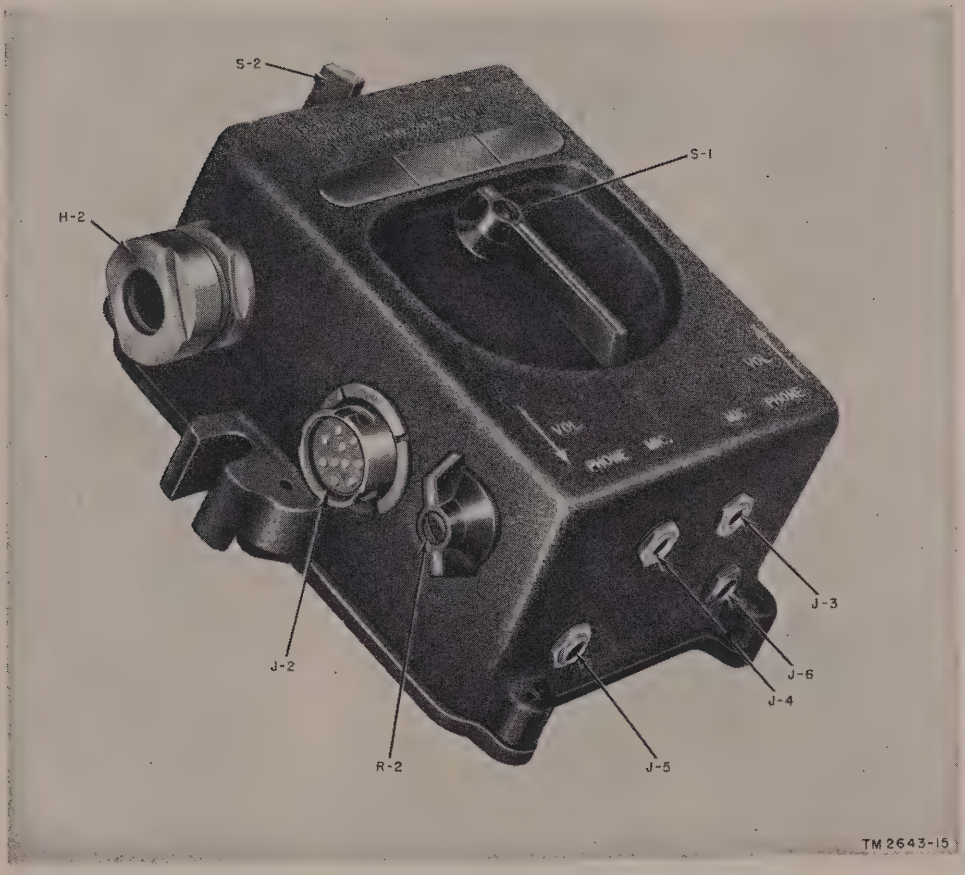


Figure 56. Control Box C-375/VRC, left oblique view.

CHAPTER 6
AUXILIARY EQUIPMENT

94. General

Auxiliary equipment is equipment which is not supplied as a part of the basic radio sets (par. 6) but which extends the application of the radio sets in some manner. The auxiliary equipment described in this chapter is Modification Kit MX–898/GR.

95. Purpose and Use of Modification Kit MX–898/GR

The modification kit is used to provide temporary field operation of the receiver-transmitter (Set 1) when it is removed from a vehicle.

96. Components of Modification Kit MX–898/GR

The components of Modification Kit MX–898/GR are listed and described below.

a. Generator G–8/GRC (fig. 57). Generator G–8/GRC is a hand-powered power source. It consists of a generator unit with cranks and mounting legs (fig. 57). Complete details on the generator are published in a separate manual.

b. Case CY–590/GRC (fig. 58).

(1) Case CY–590/GRC is a battery box which holds five series-connected 1.5-volt batteries (Battery BA–403/U) and one 90-volt battery (Battery BA–419/U).

(2) Two receptacles and a switch are mounted on the front panel of the battery case (fig. 59). The receptacles are used for interconnecting the battery case with the receiver-transmitter (Set 1) and the hand generator. The switch is used to complete or break the battery circuits to the receiver-transmitter with which the battery case is used. The REMOTE position of the switch does not apply to Radio Sets AN/VRC–13, –14, and –15.

c. Power Cable Assembly CX–1210/U. This cable is used to connect the battery case to Set 1 in field installations of Set 1, utilizing both battery case and hand generator (par. 98), or to connect the hand generator to Set 1 in field installations utilizing the hand generator only.

d. Power Cable Assembly CX–1209/U. This cable is used to connect the battery case to the hand generator in field installations of Set 1.

e. Mounting MT–652/GR. Mounting MT–652/GR (figs. 62 or 64) is used to hold the antenna masts used in field installations. The overhanging flange of the receiver-transmitter front panel has a boss which will accept the base of Mounting MT–652/GR. When the mounting is secured, the mast sections supplied with the modification kit (*f* below) can be screwed into the mounting. A rubber-covered lead-in wire, which is part of the mounting, is used to connect the antennas to the ANT post on the receiver-transmitter.

f. Mast Sections AB–22/GR, AB–23/GR, and AB–24/GR. These are short mast sections, approximately 23 inches long, which can be screwed together to obtain a whip antenna of various lengths.

g. Handset H–33/PT (fig. 15). The same handset which is supplied with Control Group AN/GRA–6 is also supplied with the modification kit. A description of the handset is given in paragraph 18.

h. Bag CW–187/GR. Bag CW–187/GR is a canvas bag which will accommodate the handset, antenna mounting, mast sections, cables, generator legs, and the technical manuals supplied with the generator.

i. Bag CW–188/GR. Two of these canvas bags are supplied with each kit. One bag is to carry the battery case and hand generator; the other bag is to carry a receiver-transmitter. The bag for the receiver-transmitter normally is stored in the other bag of the same type, when the modification kit is stored away in the vehicle.

Figure 57. Generator G–8/GRC.

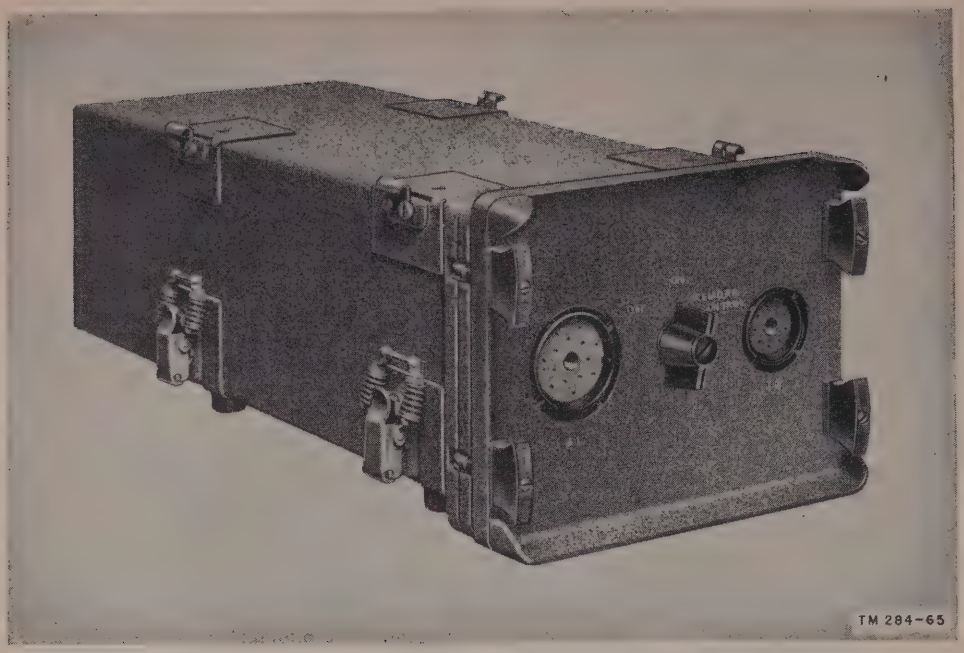


Figure 58. Case CY–590/GRC, front view.

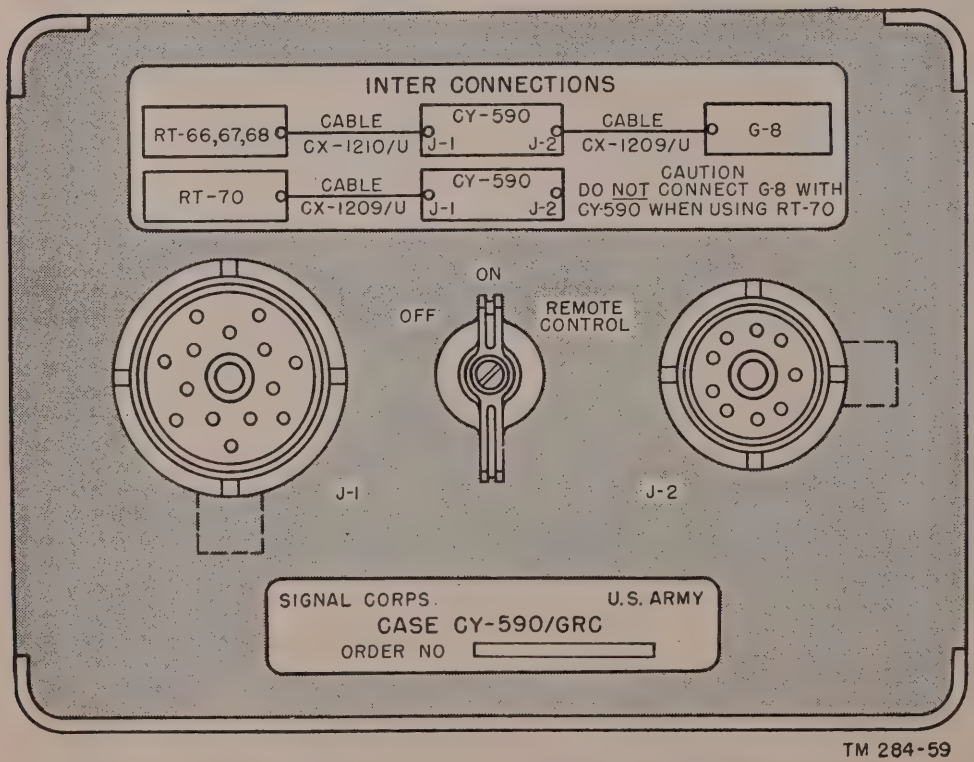


Figure 59. Case CY–590/GRC, front panel.

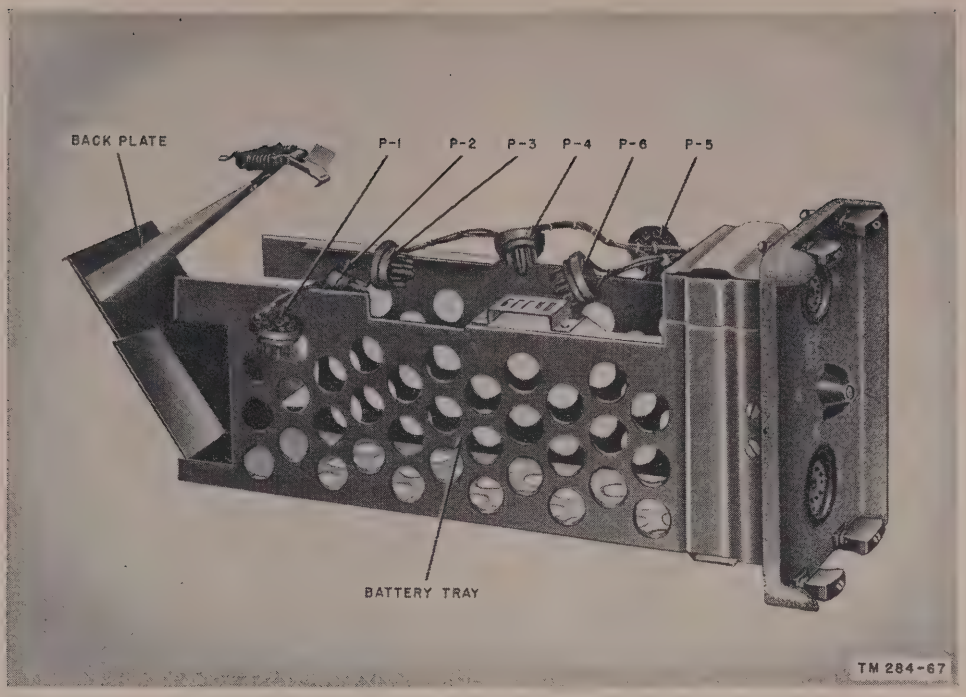


Figure 60. Case CY–590/GRC, case and batteries removed.

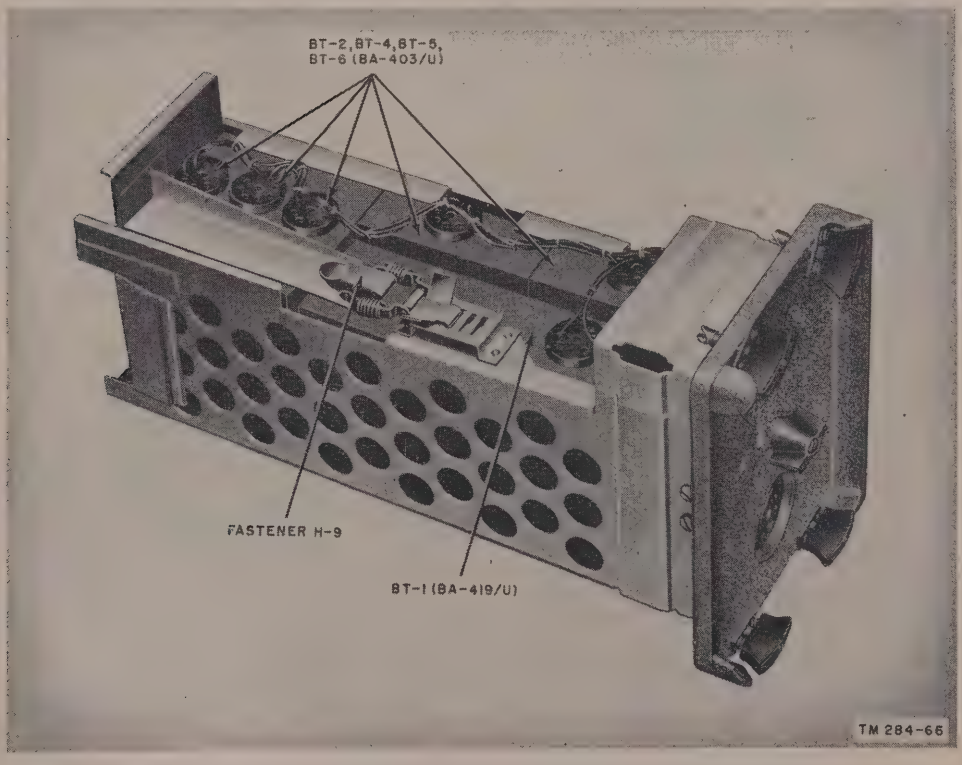


Figure 61. Case CY–590/GRC, case removed, batteries installed.

97. Packaging

The components of Modification Kit MX–898/GR are individually packed in cardboard containers but are shipped collectively in a single wooden case. Unpack as follows:

a. Remove the components from the case and remove the wrappings.

b. Loosen the Dzus fasteners on the panel of the battery case and remove the battery tray from the case (fig. 60).

c. Install five 1.5-volt batteries (Battery BA–403/U) and one 90-volt battery (Battery BA–419/U) in the case. Connect the batteries as indicated in figures 61 and 65. Replace the battery tray in the case.

d. Store the handset, antenna mounting, mast sections, cables, generator legs, and generator technical manuals in Bag CW–187/GR. Store the bag in any convenient location in the vehicle.

e. Store the battery case and the hand generator and one of Bags CW–188/GR in the other Bag CW–188/GR. Store the packed bag in some convenient location in the vehicle.

98. Operation of Set 1 with Generator and Battery Case

(fig. 62)

a. Remove Set 1 from Mounting MT–297/GR and pack it in the unused Bag CW–188/GR. Carry the three bags (two Bags CW–188/GR and one Bag CW–187/GR) to the location selected for field operation of the set.

b. Set up the generator, battery case, and receiver-transmitter, as illustrated in figure 62. Refer to the manual supplied with the generator for detailed information on that unit. Turn the OFF-ON-REMOTE CONTROL switch of the battery case to the OFF position.

c. Connect one end of Power Cable Assembly CX–1209/U to the generator and the other end to the 9-pin connector on the battery case.

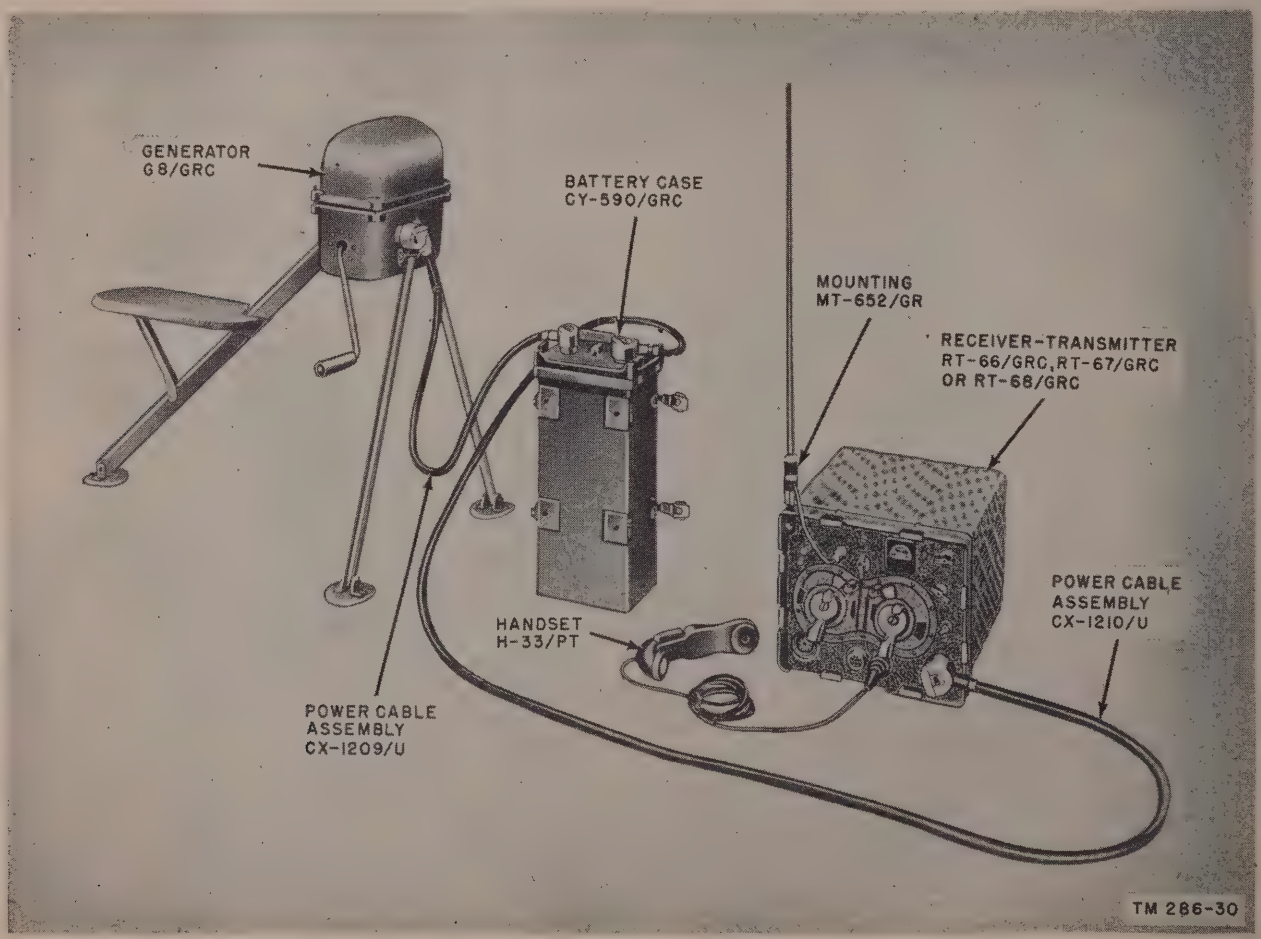


Figure 62. Field operation of Set 1 with Generator G–8/GRC and Case CY–590/GRC.

d. Connect one end of Power Cable Assembly CX–1210/U to the 14-pin connector on the battery case and the other end to the POWER IN receptacle on Set 1.

e. Insert the antenna mounting into the boss at the top front of the receiver-transmitter and turn the mounting 90° to lock it in place. Connect the lead-in wire to the ANT connector. For Receiver-Transmitters RT–66/GRC and RT–67/GRC, assemble the five mast sections and screw the assembly into the antenna mount. For Receiver-Transmitter RT–68/GRC, assemble three of the mast sections and screw the assembly into the antenna mount.

f. Connect the handset to one of the AUDIO connectors on the front of the receiver-transmitter.

g. Set the OFF-ON-REMOTE CONTROL switch of the battery case to ON. The receiver section of Set 1 is then ready for operation. It is not necessary to crank the generator while monitoring.

h. To transmit, crank the generator at a steady speed of approximately one revolution per second, press the push-to-talk button, and talk into the mouthpiece. Release the push-to-talk button and stop cranking to listen.

i. To turn off the set, stop cranking and turn the OFF-ON-REMOTE CONTROL switch to OFF.

99. Operation of Set 1 with Generator G–8/GRC

(fig. 64)

a. Remove Set 1 from Mounting MT–297/GR and pack it in Bag CW–188/GR. If the battery case is definitely not going to be used, it can be removed from the other Bag CW–188/GR to lighten the burden. Take the three bags to the location selected for field operation of the set.

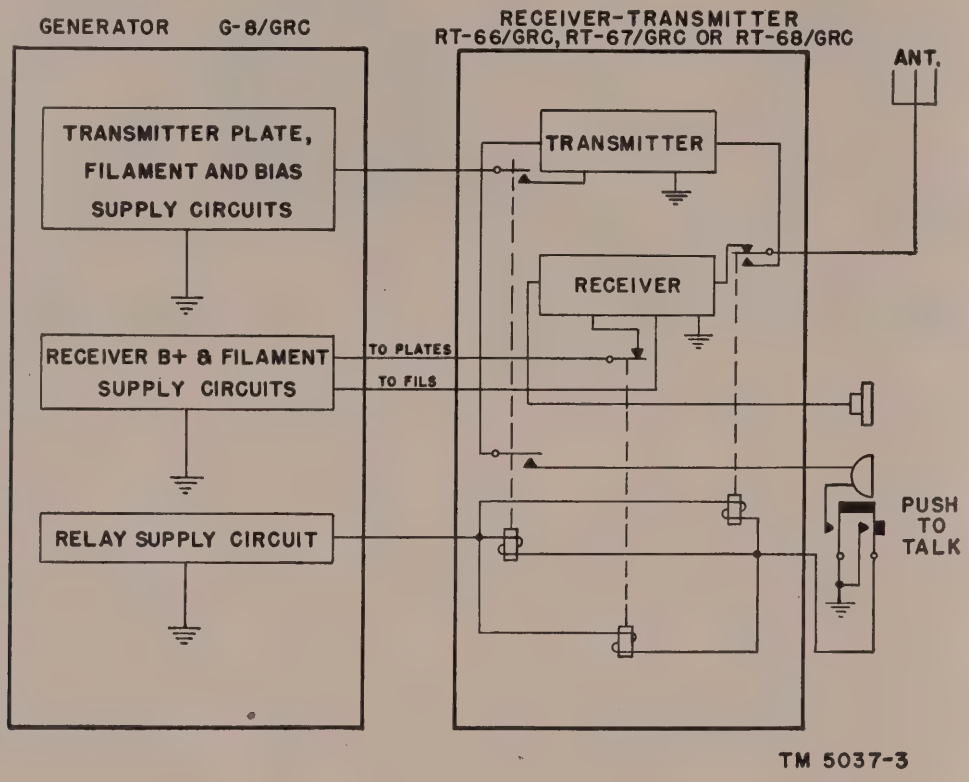


Figure 63. Auxiliary operation of Set 1, block diagram.

b. Set up the generator and Set 1 as indicated in figure 64. Connect Power Cable Assembly CX–1210/U to the generator and the other end to the POWER IN connector on Set 1. (When Set 1 is used with Generator G–8/GRC alone, the generator supplies all the operating voltages for both the receiver and the transmitter. The block diagram (fig. 63) illustrates the function of the generator.

c. Connect the antenna mount and mast

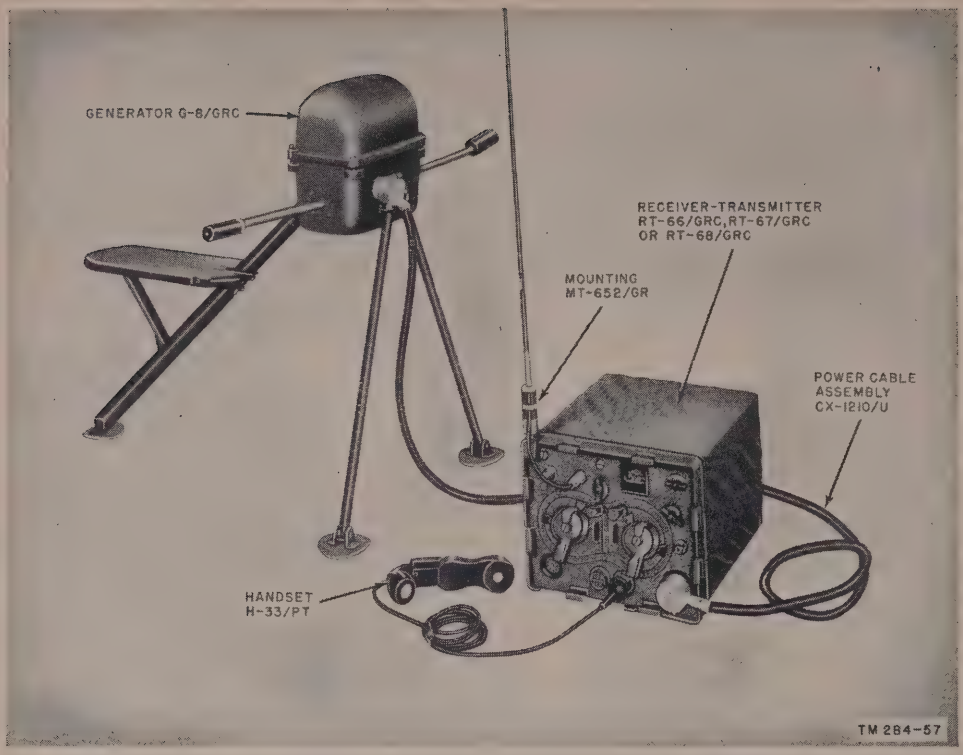
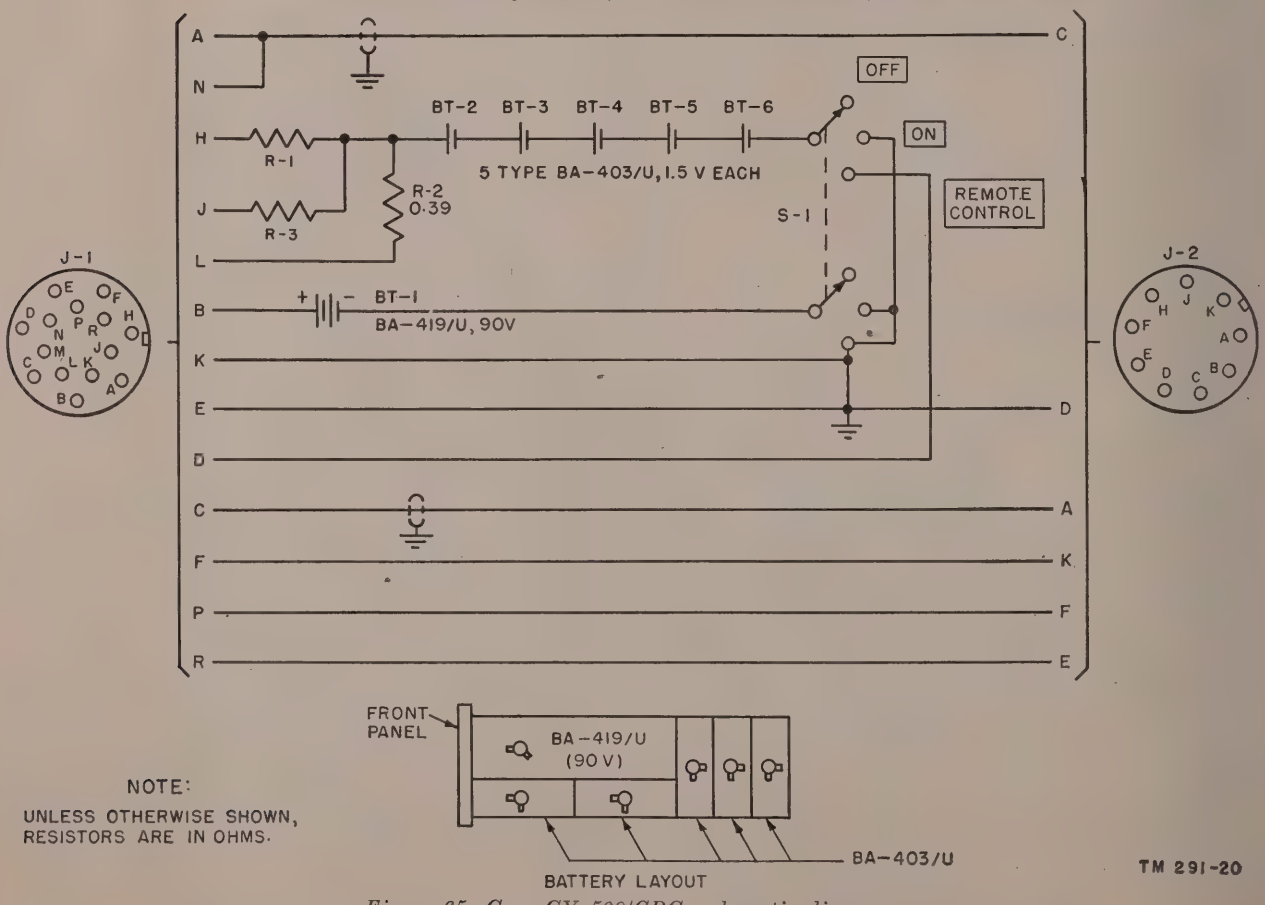


Figure 64. Field operation of Set 1 with Generator G–8/GRC.



NOTE:

UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS.

TM 291-20

Figure 65. Case CY–590/GRC, schematic diagram.

sections as directed in paragraph 98*e*. Connect the handset to an AUDIO connector on the Set 1 panel.

d. To receive, crank the generator at a steady speed of approximately 1 revolution per second, and listen with the handset. To transmit, crank the generator, press the push-to-talk button, and talk into the mouthpiece.

e. To stop the equipment, stop cranking the generator.

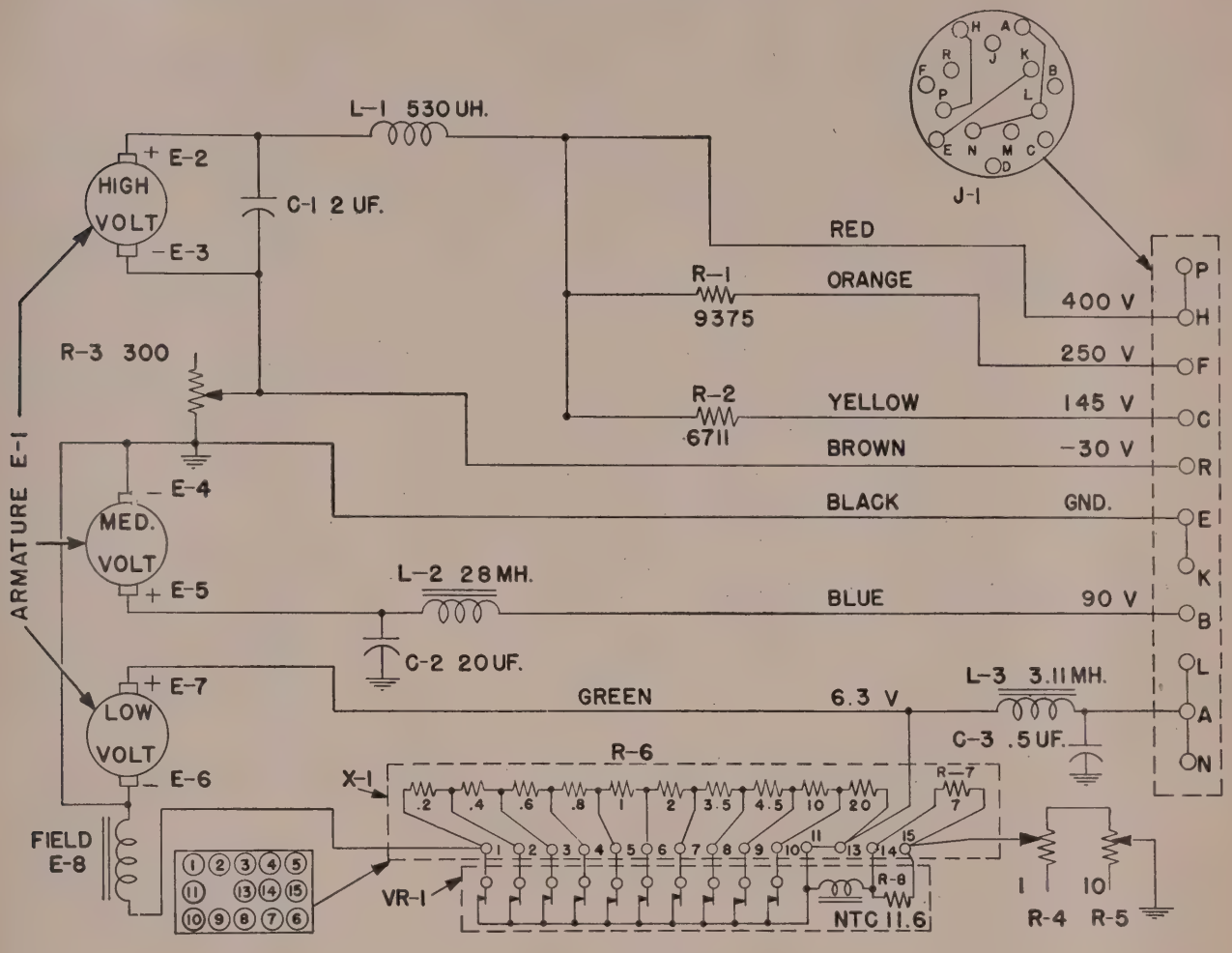


Figure 66. Generator G-8/GRC, schematic diagram.

APPENDIX I
REFERENCES

Note. For availability of items listed, check SR 310–20–3 and SR 310–20–4. Check Department of the Army Supply Catalog SIG 1 for Signal Corps supply catalogs.

1. Army Regulations

AR 380–5	Safeguarding Military Information.

2. Supply Publications

SIG 1	Introduction and Index.
SB 11–47	Preparation and Submission of Requisitions for Signal Corps Supplies.
SB 11–76	Signal Corps Kit and Materials for Moisture- and Fungi-Resistance Treatment.

3. Technical Manual on Test Equipment

TM 11–2627	Tube Tester I–177.

4. Painting and Preserving

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TM 9–2851	Painting Instructions for Field Use.

5. Demolition

FM 5–25	Explosives and Demolitions.

6. Other Publications

FM 24–18	Field Radio Techniques.
SR 310–20–3	Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications).
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, Tables of Equipment.
SR 700–45–5	Unsatisfactory Equipment Reports (Reports Control Symbol CSGLD–247)
SR 745–45–5	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), S and A–70–6 (Navy), and AF–MC–U2 (Air Force)).
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178	Preventive Maintenance Guide for Radio Communication Equipment.
TM 9–2857	Storage Batteries, Lead-Acid Type.
TM 11–430	Batteries for Signal Communication except those pertaining to Aircraft.
TM 11–453	Shop Work.
TM 11–455	Radio Fundamentals.
TM 11–483	Suppression of Radio Noises.
TM 11–486	Electrical Communication Systems Engineering.
TM 11–660	Introduction to Electronics.

TM 11–4000	Trouble Shooting and Repair of Radio Equipment.
TM 38–650	Basic Maintenance Manual.

7. Abbreviations

a-c	alternating-current
a-f	audio-frequency
afc	automatic frequency control
C	centigrade
db	decibel(s)
d-c	direct-current
F	Fahrenheit
f-m	frequency-modulation
h-f	high-frequency
h-v	high-voltage
i-f	intermediate-frequency
l-v	low-voltage
kc	kilocycle
ma	milliampere
mc	megacycle
mw	milliwatt
r-f	radio-frequency
rms	root mean square
μa	microampere
μf, $\mu\mu$f	microfarad, micromicrofarad
μv	microvolt

8. Glossary

For explanation of terms used in this manual, refer to TM 11–455.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O & E, T/A, T/BA, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. Department of the Army Supply Catalogs applicable to the equipment covered in this manual is SIG 7 & 8 C–375/VRC. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1, Introduction and Index.

1. Scope of Identification Table of Parts

Only those units that are not covered in separate technical manuals are covered in the following identification tables of parts. These units are Mounting MT–297/GR, Case CY–590/GRC, and Control Box C–375/VRC. For the other units refer to the individual technical manuals.

2. Identification Table of Parts for Mounting MT–297/GR

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ARMY-NAVY MOUNTING MT–297/GR: radio set mtg; p/o Army-Navy Radio Sets AN/VRC–13, AN/VRC–14, and AN/VRC–15; metal rack w/8 metal rack surface plates and 9 metal channels ea w/locking strip, mtd on 2 rectangular metal mtg bkt hinged at rear end, ea w/2 wing nut fasteners at front joint, ea mtg bkt supported by 4 shock mts mtd on metal hold-down plate U-shaped metal junction box mtd on under side of rack between mtg bkt, 8 cables w/connectors terminate in junction box; olive drab finish; main power ckt term 80 amp cap; rectangular box shape; 33⅝″ lg x 13⅜″ deep x 4 13/16″ h o/a; four .343″ diam mtg holes in ea hold-down plate on 3¼″ x 4⅞″ mtg/c; mp and fp, rails on inner part of U-shaped casting, and locking connector accom slide in type control unit; Fed Tele & Rad part/dwg #GA–1834–14; U. S. Army spec #71–3326.		
E–6	BOARD, terminal: wiring term board; 18 solder type term; ¼″ between ctr; molded plastic board segmented; 5⅜″ lg x 2 5/16″ wd x 1⅛″ h o/a; two .169″ x .25″ oval mtg holes on 4⅛″ mtg/c; term marked from 1 to 18, mtg bkt on ea end; p/o Fed Tele & Rad #GA–1973.14 housing assem; Fed Tele & Rad part/dwg #GA–1451–2.	Cable terminating board	3Z770–18.45.
E–2, E–5	BOARD, terminal: wiring term board; 18 solder type term; ¼″ between ctr; molded segmented plastic board; 5⅜″ lg x 2 5/16″ wd x 1⅛″ h o/a; two .169″ x .25″ oval mtg holes on 4⅛″ mtg/c; term marked from A to K and from A–1 to K–1, omitting G and I; mtg bkt on ea end; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GA–1452–2.	Cable terminating boards	3Z770–18.46.
O–2, O–3	BUSHING: shock absorber for mtg connector not in use; neoprene; 11/32″ lg x ½″ OD x ⅜″ ID; Fed Tele & Rad part/dwg #GR–2150–2.	Unused cable connectors	2Z1409–191.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H–11	BUTTON, plug: rubber substitute; fits 19/32″ diam hole; .587″ diam x 1⅜″ lg o/a; 70 to 80 durometer hardness; Fed Tele & Rad part/dwg #GR–2261–2–2; U. S. Army spec #71–4945.	Cable clamp plug	4Z3152.
W–8	CABLE ASSEMBLY, power: Sig C Cordage CO–212; 8′ 6″ lg excluding terminations; 2 Fed Tele & Rad #GH–2025–2 term lugs on 1 end, 1 on ea cond, other end terminates in 2 leads, 1 ins 4″ lg w/end bared and tinned ¾″ lg; other bare 2¼″ lg; Fed Tele & Rad part/dwg #GA–2186–12–1; cordage covered by U. S. Army spec #71–1618A.	Battery cable	3E7350.1–1024.
W–1	CABLE ASSEMBLY, power: Sig C Cordage CO–212; 19½″ lg excluding terminations; 1 end terminated in Fed Tele & Rad #GH–2200–12 plug, other end terminated in 2 leads, 1 bare 3″ lg, other ins 2″ lg w/end bared and tinned ¾″ lg; Fed Tele & Rad part/dwg #GA–2199–14–1; cordage covered U. S. Army spec #71–1618A.	Power cable	3E7350.1–19.3.
W–4	CABLE ASSEMBLY, power: Sig C Cordage CO–212; 18½″ lg excluding terminations; 1 end terminated in Fed Tele & Rad #GH–2200–12 plug, other end terminated in 2 leads, 1 ins and 1 bare ea 3½″ lg, end bared and tinned ¾″ lg; Fed Tele & Rad part/dwg #GA–2199–14–2; cordage covered by U. S. Army spec #71–1618A.	Power cable	3E7350.1–18.3.
W–5	CABLE ASSEMBLY, power: Sig C Cordage CO–212; 20″ lg excluding terminations; 1 end terminated in Fed Tele & Rad #GH–2200–12 plug, other end terminated in 2 leads, 1 bare 3½″ lg, other ins 1½″ lg w/end bared and tinned ¾″ lg; Fed Tele & Rad part/dwg #GA–2199–14–3; cordage covered by U. S. Army spec #71–1618A.	Power cable	3E7350.1–20.4.
W–3	CABLE ASSEMBLY, special purpose: Army-Navy Special Purpose Cable WM–46/U; 24½″ lg excluding terminations; 1 end terminated in Fed Tele & Rad #GH–2196–2 plug, other end terminated in 11 leads, 10 ins 6″ lg w/ends bared and tinned ½″ lg, other bare 5″ lg; Fed Tele & Rad part/dwg #GA–2085–14–3; cable covered by U. S. Army spec #71–3373.	Control cable	3E7350–1.24.3.
W–6	CABLE ASSEMBLY, special purpose: Army-Navy Special Purpose Cable WM–46/U; 21″ lg excluding terminations; 1 end terminated in Fed Tele & Rad #GH–2196–12 plug, other end terminated in 11 leads, 10 ins 6″ lg w/ends bared and tinned ½″ lg, other bare 5″ lg; Fed Tele & Rad part/dwg #GA–2085–2–7; cable covered by U. S. Army spec #72–3373.	Control cable	3E7350–1.21.
W–7	CABLE ASSEMBLY, special purpose: Army-Navy Special Purpose Cable WM–46/U; 23″ lg excluding terminations; 1 end terminated in Fed Tele & Rad #GH–2196–12 plug, other end terminated in 11 lead, 10 ins 6″ lg w/ends bared and tinned ½″ lg, other bare 5″ lg; Fed Tele & Rad part/dwg #GA–2085–14–8; cable covered by U. S. Army spec #71–3373.	Control cable	3E7350–1.23.1.
W–2	CABLE ASSEMBLY, special purpose: Army-Navy Special Purpose Cable WM–46/U; 23″ lg excluding terminations; 1 end terminated in Fed Tele & Rad #GH–2196–12 plug, other end terminated in 11 leads, 10 ins 6″ lg w/ends bared and tinned ½″ lg, other bare 5″ lg; Fed Tele & Rad part/dwg #GA–2085–14–9; cable covered by U. S. Army spec #71–3373.	Control cable	3E7350–1.23.1.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
O–4 through O–12.	CAM: p/o Fed Tele & Rad #GA–1236–14 and #GA–1263–14 rack assem; brass; generally triangular shape w/ rounded corners and bottom side; approx 1 5/32″ lg x 7/8″ wd x .475″ thk; two ctb #6–32 NC–2 mtg holes on .562″ mtg/c; slotted through approx ctr of thk; Fed Tele & Rad part/dwg #GC–1021–2.	Locking cams	4Z3185–1.
O–13	CAM: p/o Fed Tele & Rad #GA–1973–14 housing assem; passivated SS; tear drop shape; 3.7725″ lg x 2.484″ wd x 1.016″ h o/a; mts by means of hole in round portion, hole 1.937″ diam ctb 2.062″ diam x .188″ deep; 4 locking type slots in outer edge of round portion slot in arm portion .187″ wd x 1.065″ lg; Amphanol dwg #164–400; Fed Tele & Rad part/dwg #GB–1367–12.	Connector locking cam	4Z3185–2.
H–1 through H–6.	CLAMP: steel; cad pl and olive drab iridited; 1 1/16″ lg x 1¼″ diam o/a; accom .61″ diam cable; compression type clamp, has rubber gland to provide wp seal between cable and clamp, wp seal between clamp and mtg hole; Fed Tele & Rad part/dwg #GH–1966–2.	Cable clamps	2Z2642.305.
H–7 through H–10.	CLAMP: steel; cad pl and olive drab iridited; 1 1/16″ lg x 1¼″ diam o/a; accomo .516″ diam cable; compression type clamp has rubber gland to provide wp seal between cable and clamp, wp seal between clamp and mtg hole; Fed Tele & Rad part/dwg #GH–1965–2.	Cable clamps	2Z2642.300.
J–1	CONNECTOR, receptacle: 26 round female cont; straight; 2.047″ diam excluding mtg nut and lockwasher x 1.719″ lg excluding term; cylindrical, passivated SS body; molded phenolic insert; single hole mtg, 1¾″–16NS–2 x .813″ lg mtg bushing; has 0 ring wp seal on mtg bushing, supplied w/spanner type mtg nut and lockwasher; Amphenol dwg #164–10; Fed Tele & Rad part/dwg #GH–2385–12.	Receptacle, control unit connector.	2Z3082–84.
A–9, A–10	COVER: p/o Fed Tele & Rad #GA–1973–14 housing assem; aluminum alloy, olive drab finish; rectangular plate shape w/rounded corners; 9 7/16″ lg x 2 29/32″ wd x 3/8″ thk o/a; six #10–24 NC–2 tapped holes, 3 on ea longitudinal edge 3¾″ c to c; groove in bottom surface for 0 ring seal; Fed Tele & Rad part/dwg #GC–1706–12.	Junction box covers	2Z3351–209.
A–11	COVER: p/o Fed Tele & Rad #GA–1973–14 housing assem; aluminum alloy, olive drab finish; rectangular plate shape w/rounded corners; 15¼″ lg x 2 31/32″ wd x 3/8″ thk o/a; eight #10–24 NC–2 tapped holes, 3 on ea longitudinal edge 4″ c to c and 1 ctr on ea end; groove in bottom surface for 0 ring seal; Fed Tele & Rad part/dwg #GC–1707–14.	Junction box cover	2Z3351–210.
F–1	FUSE, cartridge: 50 amp; opens in 1 hr at 135% load, 2 min at 200% load rated continuous at 110% load; 32 v max; 1 time; glass body; ferrule term; 1½″ lg x 13/32″ diam o/a; term 13/32″ diam x 3/8″ lg; anti-vibration construction; Buss catalog #5AG50.	Overload protection, battery.	3Z2650.11.
F–2	FUSE, cartridge: 2 amp; opens in 1 hr at 135% load, 2 min at 200% load, rated continuous at 110% load; 250 v max; 1 time; glass body; ferrule term; 1½″ lg x 13/32″ diam o/a; term 13/32″ diam x 3/8″ lg; anti-vibration construction; Buss catalog #5AG2.	Circuit fuse	3Z2602.23.
O–28	GASKET: JW60 crude rubber compound; single hole, w/round cross sect; 10¼″ OD x 10″ ID x 1/8″ thk; p/o Fed Tele & Rad #GA–1973–14 housing assem, Linear Inc. #1866–52; Fed Tele & Rad part/dwg GS–1946–1–3.	Cover to junction box waterproof gasket.	2Z4868.785.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
0–29, 0–30	GASKET, JW60 crude rubber compound; single hole; cir w/round cross sect; 6¾″ OD x 6½″ ID x ⅛″ thk; p/o Fed Tele & Rad #GA–1973–14 housing assem; Linear Inc. #1866–38; Fed Tele & Rad part/dwg #GS–1946–1–2.	Covers to junction box waterproof gasket.	2Z4868.786.
H–12 through H–20.	HANDLE: steel, zinc pl and olive drab iridited; 2⁵⁄₁₆″ lg x 1½″ wd x 7–16 h o/a; flanged grip 1¹⁄₁₆″ lg x .059″ wd x ⅜″ h; two .154″ diam mtg holes on .562″ mtg/c; p/o Fed Tele & Rad #GA–1236–14 and #GA–1263–14 rack assem; Fed Tele & Rad part/dwg #GB–1029–2.	Mounting strip locking handles.	4Z4591.
E–9	HOLDER, fuse: block type; for single type 5AG cartridge fuse; phenolic base w/tinned brass term and fuse holder; 80 amp, 32 v DC max; 1¹³⁄₁₆″ lg x 1¹¹⁄₁₆″ wd x 1¹³⁄₁₆″ h o/a; two .169″ diam ctb mtg holes in base on 1″ mtg/c; 2-slotted compression type binding post term, 1 post having solder lug term at base; phosphor bronze locking type spring fuse clips; Burndy #KF2517G1; Fed Tele & Rad part/dwg #GH–1645–2.	Fuse holder	3Z3282–1.1.
E–10	HOLDER, fuse: block type; for single type 5AG cartridge fuse; phenolic base w/silver pl beryllium copper fuse clips; 30 amp, 32 v DC max; 1⅝″ lg x ⅞″ wd x ¹⁵⁄₁₆″ h o/a; surface mtg, two .169″ diam ctb mtg holes on .313″ x .25″ mtg/c; 2 solder lug term; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GH–1876–2.	Fuse holder	3Z3282–20.6.
E–13, E–14	INSULATOR, plate: rectangular shape; type LTS–E–3 phenolic, natural; 1½″ lg x 1¹⁄₁₆″ wd x .062″ thk; two .169″ diam mtg holes on 1″ mtg/c; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GP–1974–2–1.	Terminal assembly mounting insulators.	3G320–165.
E–15	INSULATOR, plate: rectangular shape; type LTS–E–3 phenolic, natural; 1¹³⁄₁₆″ lg x 1¹¹⁄₁₆″ wd x .062″ thk; two .169″ diam mtg holes on 1″ mtg/c; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GP–1975–2.	Fuseholder mounting insulator.	3G320–166.
E–16	INSULATOR, plate: rectangular shape type LTS–E–3 phenolic, natural; 1⅝″ lg x ⅝″ wd x .062″ thk; two .169″ diam mtg holes on .313″ x .25″ mtg/c; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GP–1976–2.	Fuseholder mounting insulator.	3G320–167.
E–17	JUNCTION BOX: ten .828″ diam outlet holes; aluminum alloy, olive drab finish; w/o covers; U-shaped, 15⅜″ lg x 12⁹⁄₁₆″ wd x 3⅝″ h o/a; 4 mtg bosses on top side ea/w ¼″–20 NC–2 x ⁹⁄₁₆″ deep tapped hole on 7″ x 11¼″ mtg/c; has slotted rails on ea side of inside of U to accommodate control unit and has provision for installing lever shaft and connector locking cam, and chassis connector; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GA–2099–12.	Cable terminating junction box.	2Z5687–35.
E–18	KNOB: round w/bar; olive drab zinc alloy; for ¼″ diam double flatted shaft; single #6–32 screw through hole in face of knob screws into axially tapped hole in end of shaft; 2 white luminous lines on bar portion; 1⁷⁄₁₆″ lg x ⅞″ wd x ¹⁵⁄₃₂″ h o/a; shaft hole .359″ deep from bottom surface; luminous markings; Fed Tele & Rad part/dwg #GC–1690–2.	Switch knob	2Z5822–401.
N–1	LABEL: decalcomania; 1¹³⁄₁₆″ wd x 9⅞″ lg x .007″ thk; white print on black background; individually packed; Meyer cord type G; Fed Tele & Rad part/dwg #GD–1240–26; Sig C dwg #SC–D–40605–A.	Circuit label for Mounting MT-297/GR.	6D16777–9

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E–7	LAMP, incandescent: Sig C Lamp IM–38; 28 v, .17-amp; bulb T–3¼ clear; 1⅛″ lg o/a; miniature bayonet base; C–2 fil; burn any position; Mazda catalog #313.	Pilot light	2Z5938.
W–9, W–10	LEAD, electrical: single #5 AWG, 36180 cir mil, braided cond, 360 #30 AWG strands, uninsulated, flat ribbon shape approx ⅝″ wd x ⅛″ thk; 5½″ lg excluding term; flattened tubing ends w/.257″ diam hole, other w/.328″ diam hole; p/o Army-Navy Mounting MT–297/GR; Fed Tele & Rad part/dwg #GB–1179–2–2.	Grounding straps	3E7998–5.9.
I–1	LIGHT, indicator: w/lens; 9/16″ diam clear lens; for miniature bayonet base, T–3¼ bulb; 110 v, ¼ amp; encl shell; aluminum alloy olive drab; 2⅞″ lg x 13/16″ diam o/a; 9/16″ diam mtg hole required, ¼″ max panel thk; vertical mtg socket, lamp replaceable from rear of panel; threaded jewel; 2 solder lug term located together on rear end of socket; built in mechanical dimmer, 2 clear up internal lenses, wp seal between bushing and panel; Dialco dwg #832210–XP4–721; Fed Tele & Rad part/dwg #GH–1964–2.	Pilot light socket	#2Z5991–184.
A–1 through A–8.	MOUNT, vibration: Sig C Shock Mount M–449; sq mtg; load rating 17 to 30 lb; 2⅜″ sq x 1.058″ thk o/a; rubber shock cushion on either side of metal mtg plate 1½″ diam x ⅜″ thk; steel sleeve w/.251″ diam hole, hole extends through sleeve untapped for 9/16″ deep ea end, tapped on ctr ¼″–28 NF–2; four .199″ diam mtg holes on 1.937″ x 1.937″ mtg/c; olive drab finish; marked w/M–449, load rating, and mfr name; Sig C dwg #SC–D–19169, Group 3, spec #12–121.	Shock mounts	2Z8415–449.
H–21	NUT, castellated; steel, cad pl and olive drab iridited; finished per dwg; ⅜″–32 NS–2; ⅛″ thk, 9/16″ OD; 4 slots 3/32″ wd x 3/64″ deep spaced 90 deg apart; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GB–1106–2.	Switch mounting nut	6L3006–325.
H–22, H–23	PIN, hinge: steel, zinc pl and olive drab iridited; .312″ diam x 4½″ lg; both ends chamfered 1/32″ x 45 deg, one .076″ diam hole through ea end of pin ⅛″ from end; Fed Tele & Rad part/dwg #GB–1325–2.	Pins for hinges	6L3945–72–1.
E–4, E–12	POST, binding: compression screw type; 1½″ lg x ½″ wd x 17/32″ h; no mtg stud; two .169″ diam ctb mtg holes on 1.062″ mtg/c; brass tinned; slotted wire hole accom up to two #8 wires; hexagon compression nut w/wire cont insert, has solder lug term on side of base; Burndy #KFF17G1; Fed Tele & Rad part/dwg #GH–1647–2.	Ground terminals	3Z741–2.
E–1, E–3	POST, binding: compression screw type; 1½″ lg x 11/16″ wd x 1½″ h; no mtg stud; two .169″ diam ctb mtg holes on 1″ mtg/c; brass stud, tinned; w/phenolic mtg base; slotted wire hole accom up to two #8 wires; hexagon compression nut w/wire cont insert, has solder lug term on side of base; Burndy #KF1S17G1; Fed Tele & Rad part/dwg #GH–1646–2.	Cable terminals	3Z741–2.1.
O–1	RELAY, armature: 3B; cont rated 100 ma at 150 v; palladium cont; single winding, 12.6 v DC nominal, pull in v 8 v DC, max oper v 16 v DC, 144 ohms, ins; solder lug term on coil and cont; 2 3/16″ lg x 1⅝″ wd x 2 7/16″ h max o/a; two .221″ diam holes on 1¾″ mtg/c; fast acting; Adv Elec #A8775–1Y, Dunco #181XXC100; Fed Tele & Rad part/dwg #GH1648–2.	Control relay	2Z7599A–251.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
K–1	RELAY, solenoid: SPST, normally open; cont rated 50 amp DC at 28 v; silver cont; single winding, operates on 10 v DC, continuously withstands 16 v DC, 27.5 ohms resistance, ins, two #10–32 NF–2 stud term on cont; two #6–32 NC–2 stud term on coil; 3¼″ lg x 1⅞″ wd x 2 17/32″ max h; 2 clearance holes for #10–24 screws on 2¾″ mtg/c; fast acting; mp and fp; #101EXX107 or Adv Elec #B5–12Y, or Leach Relay #7064–91B; Fed Tele & Rad part/dwg #GH–1679–12.	Power relay	2Z7586–193.
R–3	RESISTOR, fixed: WW; 28 ohms ±5%; 12 w; JAN type RW32G280.	Voltage-dropping resistor for K–1.	3RW15002.
R–1, R–2	RESISTOR, fixed: WW; 140 ohms ±5%; 8 w; JAN type RW29G141.	Voltage-dropping resistors for O–1.	3RW19216.
H–24 through H–27.	SCREW, cap: slotted hex head drive; hex head, finished per dwg; steel, normal hardness, cad pl and olive drab iridited; ¼″–20 NC–2; ⅜″ lg; thd entire lg; slot 1/16″ wd x 3/32″ deep; Fed Tele & Rad part/dwg #GB–1110–2–1.	Rack-to-bracket mounting screws.	6L4904–20–6.
H–28 through H–37.	SCREW, cap: slot drive; hex head semi-finished; steel, cad pl and olive drab iridited; 5/16″–24 NF–2; 1¼″ lg; thd 1 1/16″ of lg; slot in head 1/16″ wd x 3/32″ deep; Fed Tele & Rad part/dwg #GB–2065–2–1.	Equipment installation screws.	6L4905–205.
H–38 through H–47.	SCREW, cap: slot drive; hex head, semifinished; steel, cad pl and olive drab iridited; 5/16″–24 NF–2; ¾″ lg; thd 9/16″ of lg; slot in head 1/16″ wd x 3/32″ deep; Fed Tele & Rad part/dwg #GB–2065–2–2.	Equipment installation screws.	6L4905–125.
H–48 through H–67.	SCREW, captive: slot drive; finished fillister Bind H per dwg; cold finished steel, cad pl and olive drab iridited; #10–24 NC–2; .937″ lg; thd portion .281″ lg; head 5/16″ diam x ⅛″ thk; p/o Fed Tele & Rad #GA–1973–14 housing assem; Fed Tele & Rad part/dwg #GB–1772–2.	Junction box cover mounting screws.	6L4770–15.196.
H–68 through H–76.	SCREW, dowel: p/o Fed Tele & Rad #GA–1236–14 and #GA–1263–14 rack assem; cold finished steel, zinc pl and olive drab iridited; .625″ lg x .278″ diam o/a; thd portion #6–32 NC–2 x 19/64″ lg; slot drive, slot 3/64″ wd x 1/16″ deep; Fed Tele & Rad part/dwg #GB–2520–2–1.	Handle, cam, and locking strip assembly screws.	6L5014–10.
H–77 through H–85.	SCREW, dowel: p/o Fed Tele & Rad #GA–2136–14 and #GA–1263–14 rack assem; cold finished steel, zinc pl and olive drab iridited; .42″ lg x .278″ diam o/a; thd portion #6–32 NC–2 x 19/64″ lg; slot drive, slot 3/64″ wd x 1/16″ deep; Fed Tele & Rad part/dwg #GB–2520–2–2.	Handle and cam assembly screws.	6L5014–6–1.
H–86 through H–89.	SCREW, thumb: wing head; steel, cad pl and olive drab iridited; 5/16″–18 NC–2; 1¼″ lg; thd entire lg; flat point; head 19/36″ wd x 9/16″ h; hole through thd portion .076″ diam, 5/32″ from end; Fed Tele & Rad part/dwg #GH–1201–2.	Stand assembly (hinged) locking screws.	6L17504–4.
O–14	SHAFT ASSEMBLY: p/o Fed Tele & Rad GA–1973–14 housing assem; c/o 1 Fed Tele & Rad #GB–1773–2 shaft, 1 #GC–1316–2 handle, and 1 #GC–1796–2 arm; 10¼″ lg x 1¼″ wd x 2⅞″ h approx o/a; mts by means of shaft; knob on 1 end of shaft, arm on other end, shaft flush at both ends; Fed Tele & Rad part/dwg #GA–1774–2.	Connector locking cam operating sahft.	2Z8201.69.
O–15 through O–18.	SLEEVE, spacer: p/o Fed Tele & Rad #GA–1236–14 and #GA–1263–14 rack assem; steel, zinc pl and olive drab iridited; tubr shape; ½″ OD x .282″ ID x .678″ lg; mts by means of ID; Fed Tele & Rad part/dwg #GB–1232–2.	Rack-to-bracket mounting spacers.	2Z8552–71.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
O–19 through O–27.	SPRING: helical extension type; .04″ diam music wire, zinc pl and olive drab iridited; 1.86″ lg x .375″ diam; 27½ turns, close wound; parallel hook term; term bent on .1375″ rad on 1.51125″ mtg/c; heat treated after plating; p/o Fed Tele & Rad #GA–1236–14 and #GA–1263–14 rack assem; Fed Tele & Rad part/dwg #GB–1104–2.	Locking strip tension springs.	2Z8879–323.
S–1	SWITCH, rotary: 2 pole, 3 position; single sect; silver pl brass cont; ceramic wafer; 1⅞″ lg x 1⅝″ wd x 1″ deep; locking action; solder lug term; single hole mtg, bushing ⅜″–32 x 5/16″ lg, shaft ¼″ diam x ⅜″ lg w/double flats and axially tapped hole #6–32 NC–2 x ¼″ deep, flush mtg; wp seal in bushing and in mtg flange; Oak type FC or equal; Fed tele & Rad prt/dwg #GH–1641–2.	Control switch	3Z9825–62.516.
E–8, E–11	TERMINAL, lug: ring type; copper, hot tin dipped; for #8 AWG wire; 1⅜″ lg x 9/16″ wd x ⅜″ thk o/a w/9/32″ diam stud hole; solder connects to wire; marked 70A; Atlas Products #W–70–A; Fed Tele & Rad part/dwg #GH–2025–2.	Battery cable terminals	3Z12073–53.
H–90, H–91	WASHER, flat: neoprene; round, 1 3/16″ OD x 13/32″ ID x ⅛″ thk; 50–60 durometer hardness; Fed Tele & Rad part/dwg GR–2149–2.	Unused cable connector mounting shock-absorbing washers.	6L54006–21.

3. Identification Table of Parts for Case CY–590/GRC

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ARMY-NAVY CASE CY–590/GRC: battery; aluminum, olive drab finish; 15⅝″ lg x 7¼″ wd x 5⅜″ h o/a; removable front panel has metal battery holder which slides into case; immersion and fungus resistant; 2 lock strikes on upper, 2 spring catches on lower edge of ea side; 4 positioning studs on bottom side, 4 positioning holes on top side of case; p/o Army-Navy Radio Set AN/PRC–16; Fed Tele & Rad dwg #GA–2415–14; U. S. Army spec #71–3331.		2Z1891–590.
	Technical Manual (TM 11–284)		(Order through AGO channels.)
	Technical Manual (TM 11–286)		(Order through AGO channels.)
	Technical Manual (TM 11–291)		(Order through AGO channels.)
H–5 through H–9	CATCH, fastener: p/o Army-Navy AF Amplifier AM–65/GRC and Army-Navy Case CY– 590/GRC; c/o back plate, lever, 2 ea outside and inside links, 2 pins, and 2 springs; steel, zinc pl and olive drab iridited; 2 1/16″ lg x 1 1/16″ wd x ½″ deep in locked position; two .144″ diam mtg holes on back plate, .437″ c to c; Fed Tele & Rad part/dwg #SC–D–20648; Sig C dwg #SC–D–20648.	H–5 through H–8: Mounting catches. H–9: Battery tray fastener catch.	6Z1747–36.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
P–6	CONNECTOR, plug: 8 round male cont; straight; 5 5/64″ lg x 1 5/32″ diam o/a; round black phenolic body; mts by means of keyed ctr locating pin and cont; 2 square keys on ctr locating pin 135 deg apart; Fed Tele & Rad part/dwg #ES–A–83778; Sig C dwg #ES–A–83778.	B battery connector	2Z3028–56.
P–1 through P–5	CONNECTOR, plug: 8 round male cont; straight; 5 5/64″ lg x 1 5/32″ diam o/a; round black phenolic body; mts by means of keyed ctr locating pin and cont; 2 rounded keys on ctr locating pin 90 deg apart; Fed Tele & Rad part/dwg #ES–A–83777; Sig C dwg #ES–A–83777.	A battery connectors	2Z3028–57.
J–2	CONNECTOR, receptacle: 9 round female cont; cont rated 10 amp at 800 v AC; Amphenol dwg #164.3; Fed Tele & Rad part/dwg #GH–2082–12.	Generator input connector	2Z3070–49.
J–1	CONNECTOR, receptacle: 14 round female cont; cont rated 10 amp at 800 v AC; Amphenol dwg #164–5; Fed Tele & Rad part/dwg #GH–2083–12.	Output connector	2Z3075–26.
H–1 through H–4.	FASTENER, Dzus: die cast zinc and steel, olive drab finish; 1 5/8″ lg x 1 5/16″ wd x 5/16″ thk o/a; mts by shaft through 1/4″ diam clearance hole; preloaded spring pressure, unlocked approx 32 lb, locked 45 lb; Dzus dwg #X–486; Fed Tele & Rad part/dwg #GA–2178–2.	Panel-to-case fasteners	6Z3809–27.
O–5	GASKET: Buna N or neoprene; single hole; rectangular, 6.6″ lg x 4.85″ wd x .187″ thk; hole 6.12″ lg x 4.37″ wd; Fed Tele & Rad part/dwg #GR–1443–12–5.	Panel-to-case waterproofed gasket	2Z4867–691.
H–16 through H–19.	INSERT, threaded: steel, cad pl and olive drab iridited; generally rectangular w/2 rounded corners; 2 9/32″ lg x 1 1/32″ wd x .1196″ thk; two #6–32 NC–2 tapped holes on .531″ ctr; Fed Tele & Rad part/dwg #GB–1171–2.	Strike mounting screws, retaining inserts (nuts).	2Z5400–52.
H–20 through H–23.	INSERT, threaded: steel, cad pl and olive drab iridited; generally rectangular w/1 rounded end; 1 5/8″ lg x 3/8″ wd x .1196″ thk; two #6–32 NC–2 tapped holes on .437″ ctr; Fed Tele & Rad part/dwg #GB–1172–2.	Catch mounting screws, retaining inserts (nuts).	2Z5400–56.
E–1, E–2.	INSULATOR, standoff: round post shape; natural or black grade LTS E–4 phenolic w/electro tin pl brass term lug, and cad pl and clear iridited hex brass mtg base and stud; 13/16″ lg o/a; 600 v RMS breakdown; 5/16″ diam o/a; single #6–32 NC–2 x 1/4″ lg mtg stud; Fed Tele & Rad part/dwg #GN–2198–2.	Wiring terminal posts	3G350–106.
E–3	KNOB: round; w/bar; olive drab zinc alloy; for 1/4″ diam double flatted shaft; single #6–32 screw through hole in face of knob screws into tapped axial hole in end of shaft; 2 white luminous lines on bar portion; 1 1/16″ lg x 7/8″ wd x 15/32″ h o/a; shaft hole .359″deep from bottom surface; luminous markings; Fed Tele & Rad part/dwg #GC–1690–2.	Switch knob	2Z5822–401.
N–1	LABEL: decalcomania; 4 5/8″ lg x 2 7/8″ wd x .007″ thk; white print on black background; individually packed; Meyer cord type G; Fed Tele & Rad part/dwg #GD–2424–12; Sig C dwg #SC–C–40596–A.	Circuit label	6D16777–11.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H–10	NUT, castellated: steel, cad pl and olive drab iridited; finished per dwg; 3/8″–32 NS–2; 1/8″ thk, 9/16″ OD; 4 slots 3/32″ wd x 3/64″ deep spaced 90 deg apart; Fed Tele & Rad part/dwg #GB–1106–2.	Switch mounting nut	6L3006–32S.
R–2	RESISTOR, fixed: WW; 39 ohms ±10%; ½ w; JAN type RU3BR39K.	Set 2 filament-dropping resistor	3RU02400.
R–3	RESISTOR, fixed: 10 ohms ±10%; 2 w; IRC #BW–2.	Set 2 relay-dropping resistor	3Z6001–146.
R–1	RESISTOR, fixed: WW; 1.2 ohms ±10%; 2 w; IRC #BW–2.	Set 1 filament-dropping resistor	3Z5991B2.
0–1 through 0–4.	SPRING: loop type; strike for Dzus fastener; .08″ diam olive drab iridited music wire; 1 3/8″ lg x 5/32″ wd x .08″ thk o/a; 2 ends turned perpendicular at 90 deg angle to straight portion on 1/16″ rad; Dzus dwg #X–487; Fed Tele & Rad part/dwg #GB–2414–2.	Fastener strikes	6Z8377–10.
H–11 through H–14.	STRIKE, fastener: steel, cad pl and olive drab iridited; 7/8″ lg x 9/16″ wd x 1 1/32″ h o/a; two .169″ diam mtg holes, .531″ c to c; 1 edge shaped into hook on 1/16″ inside rad x 1 9/32″ wd to provide catch action; Fed Tele & Rad part/dwg #GB–3035–2.	Mounting fastener strikes	6Z8569–4.
H–15	STRIKE, fastener: steel, electro tin pl; rectangular; 4″ lg x 1″ wd x 3/8″ h o/a; four .136″ diam mtg holes, 2 on ea end on 9/16″ x 3 5/8″ mtg/c; ctr portion raised and has five 1/8″ x 9/16″ slots; Fed Tele & Rad part/dwg #GB–1762–2.	Battery tray fastener strike	6Z8569–6.
S–1	SWITCH, rotary: 2 pole, 3 position; single sect; silver pl brass cont; ceramic wafer; 1 7/8″ lg x 1 5/8″ wd x 2 9/32″ deep from mtg surface; nonshorting cont; locking action; solder lug term; single hole mtg, 3/8″–32 x 3/8″ lg mtg bushing, shaft 1/4″ diam x 1 1/16″ lg from mtg surface; Oak #HIC; Fed Tele & Rad part/dwg #GH–2097–2.	OFF-ON REMOTE CONTROL switch.	3Z9825–62.531.
	ARMY-NAVY CONTROL BOX C–375/VRC: interphone and radio push-to-talk operation.	Remote control for interphone amplifier and radio sets.	2C666–375.
	BOARD, terminal: general purpose; 2 solder lug term, copper silver pl; 1 5/16″ lg x 2 9/32″ h x 5/16″ thk o/a.	Junction point for interunit connections.	3Z770–2.49.
H–1, H–2.	CLAMP: used to hold cable and wp cable entrance; wp.	Secure interconnecting Special Purpose Cables WM–46/U.	2Z2642.241.
J–1, J–2.	CONNECTOR, receptacle: Army-Navy Receptacle Connector U–79/U; 10 cont, pol; straight.	Connectors for audio input, output, and control circuits.	2Z7250–79.
A–2	COVER	Used to waterproof Jack JK–33–C and Jack JK–34–C.	2Z3352.224.
J–3, J–4.	JACK: Sig C Jack JK–33–C: for 3 cond plug, .2065″ diam x 1.093″ lg.	Connect microphone to audio input circuit.	2Z5533C.
J–5, J–6.	JACK: Sig C Jack JK–34–C: for 2 cond plug, .250″ diam x 1 7/32″ lg.	Connect headset to output of audio circuit.	2Z5534C.
	KNOB: bar; aluminum, olive drab finish; for 1/4″ diam double flatted shaft; luminous ctr line; 1 3/16″ lg x 7/8″ wd x 15/32″ thk.	For shaft of volume controls	2Z5821–147.
	KNOB: bar; aluminum, olive drab finish; for 1/4″ diam double flatted shaft; luminous ctr line; 1 15/16″ lg x 7/8″ wd x 15/32″ thk.	For shaft of switch S–2 (RADIO TRANS).	2Z5821–148.
	KNOB: bar; aluminum, olive drab finish; for 1/4″ diam double flatted shaft; luminous ctr line; 2 15/16″ lg x 7/8″ wd x 7/16″ thk.	For shaft of selector switch S–1	2Z5821–149.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R–1, R–2	RESISTOR, variable: comp; 10,000 ohms 10%; 2.25 w.	Volume controls for audio output	3Z7410–149.
S–2	SWITCH, rotary: 2 pole, 3 position	Selects interphone amplifier and radio sets for transmitting.	3Z9825–34.2.
S–1	SWITCH, rotary: 3 pole, 3 position	Selects interphone amplifier and radio sets for monitoring and transmitting.	3Z9825–34.1.

APPENDIX III

RELATED RADIO SETS

1. Basis of Relationship

(fig 82)

The major components of the radio sets discussed in this manual are common to numerous other sets which utilize common or over-lapping frequency ranges. The frequency spectrum chart (fig. 2) indicates how the sets are related so far as frequency coverage is concerned. Physical similarities among the sets are indicated in the comparison chart included below.

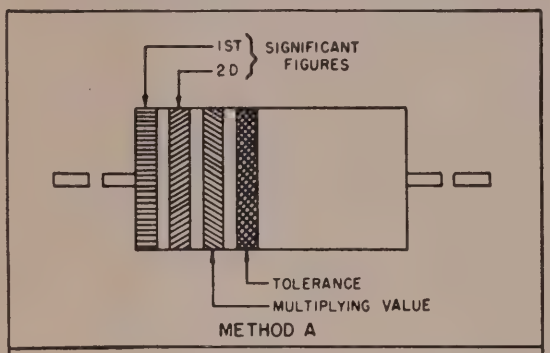
2. Comparison Chart

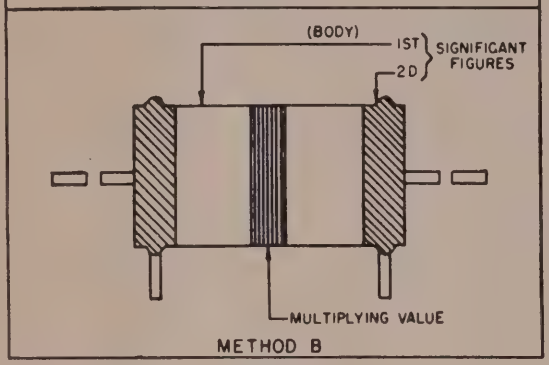
The following chart lists the components of the radio sets discussed in this manual and the components of related radio sets. Analysis of the chart will reveal the high degree of similarity which exists among the sets.

Components	Radio Sets																	Intercommunication Set AN/UIC-1	Modification Kit MX-398/GR
	AN/GRC-3	AN/GRC-5	AN/GRC-7	AN/GRC-4	AN/GRC-6	AN/GRC-8	AN/VRC-8	AN/VRC-9	AN/VRC-10	AN/VRC-13	AN/VRC-14	AN/VRC-15	AN/VRQ-1	AN/VRQ-2	AN/VRQ-3	AN/VRC-7	AN/PRC-16		
Case CY-684/GR	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1			
Case CY-590/GRC																	1		1
Mounting MT-297/GR	1	1	1	1	1	1				1	1	1							
Mounting MT-298/GR													1	1	1				
Mounting MT-299/GR							1	1	1										
Mounting MT-300/GR																1		1	
Mounting MT-652/GR																	1		1
Mounting MT-673/UR																	1		
Receiver-Transmitter RT-66/GRC	1			1			1			1			2						
Receiver-Transmitter RT-67/GRC		1			1			1			1			2					
Receiver-Transmitter RT-68/GRC			1			1			1			1			2				
Receiver-Transmitter RT-70/GRC	1	1	1	1	1	1										1	1		
AF Amplifier AM-65/GRC	1	1	1	1	1	1				1	1	1				1		1	
Power Supply PP-281/GRC or PP-282/GRC	2	2	2	1	1	1				1	1	1				1		1	
Power Supply PP-448/GR																1			
Radio Receiver R-108/GRC	1																		
Radio Receiver R-109/GRC		1																	
Radio Receiver R-110/GRC			1																
Power Supply PP-109/GR or PP-112/GR	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2				
Control Group AN/GRA-6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Control C-435/GRC	1	1	1	1	1	1							1	1	1				
Control Box C-375/VRC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		2	
Mast Base AB-15/GR	2	2	2	2	2	2	1	1	1	1	1		2	2	2	1			
Mast Section MS-116-A	2	2		2	2		2	2		2	2		4	4					
Mast Section MS-117-A	2	2	2	2	2	2	2	2	2	2	2	2	4	4	4				
Mast Section MS-118-A	2	2		2	2		2	2		2	2		4	4					
Mast Section AB-22/GR	2	2	2	2	2	2										2	2		1
Mast Section AB-23/GR																			3
Mast Section AB-24/GR	2	2	4	2	2	4			2			2			4	2	2		1
Generator G-8/GRC																			1
Handset H-33/PT																	1		
Special Purpose Cable Assembly CX-1211/U	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2				
Special Purpose Cable Assembly CX-1213/U	1	1	1	1	1	1										1			
Special Purpose Cable WM-46/U	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
RF Cable Assembly CG-568/U	1			1			1			1			2						
RF Cable Assembly CG-530/U	1	2	2	1	2	2		1	1		1	1		2	2	1			
Power Cable Assembly CX-1209/U																	1		1
Power Cable Assembly CX-1210/U																			1
Bag CW-187/GR																			1
Bag CW-188/GR																			1
Adapter UG-273/U	2	2	2	2	2	2	1	1	1	1	1	1	2	2	2				
Installation kit	1	1	1	1	1	1	1	1	1				2	2	2				
Wire W-142	1	1	1																
Adapter UG-306/U	2	2	2	2	2	2				1	1	1							
Bag CW-206/GR	1	1	1	1	1	1				1	1	1							
Connector and bond nut (Appl.)	1	1	1	1	1	1				1	1	1						1	

RESISTOR COLOR CODES

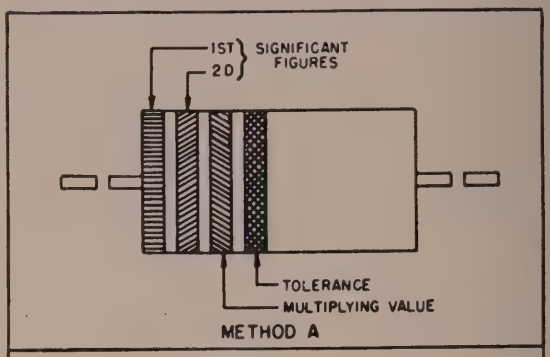
RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*

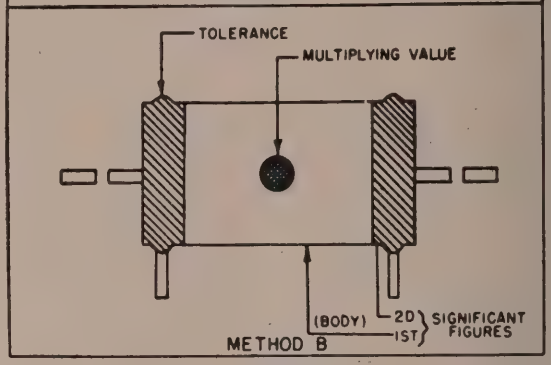




A

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS/





B

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± –
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	–	0.1	± 5
SILVER	–	0.01	± 10
NO COLOR	–	–	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

/ RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.

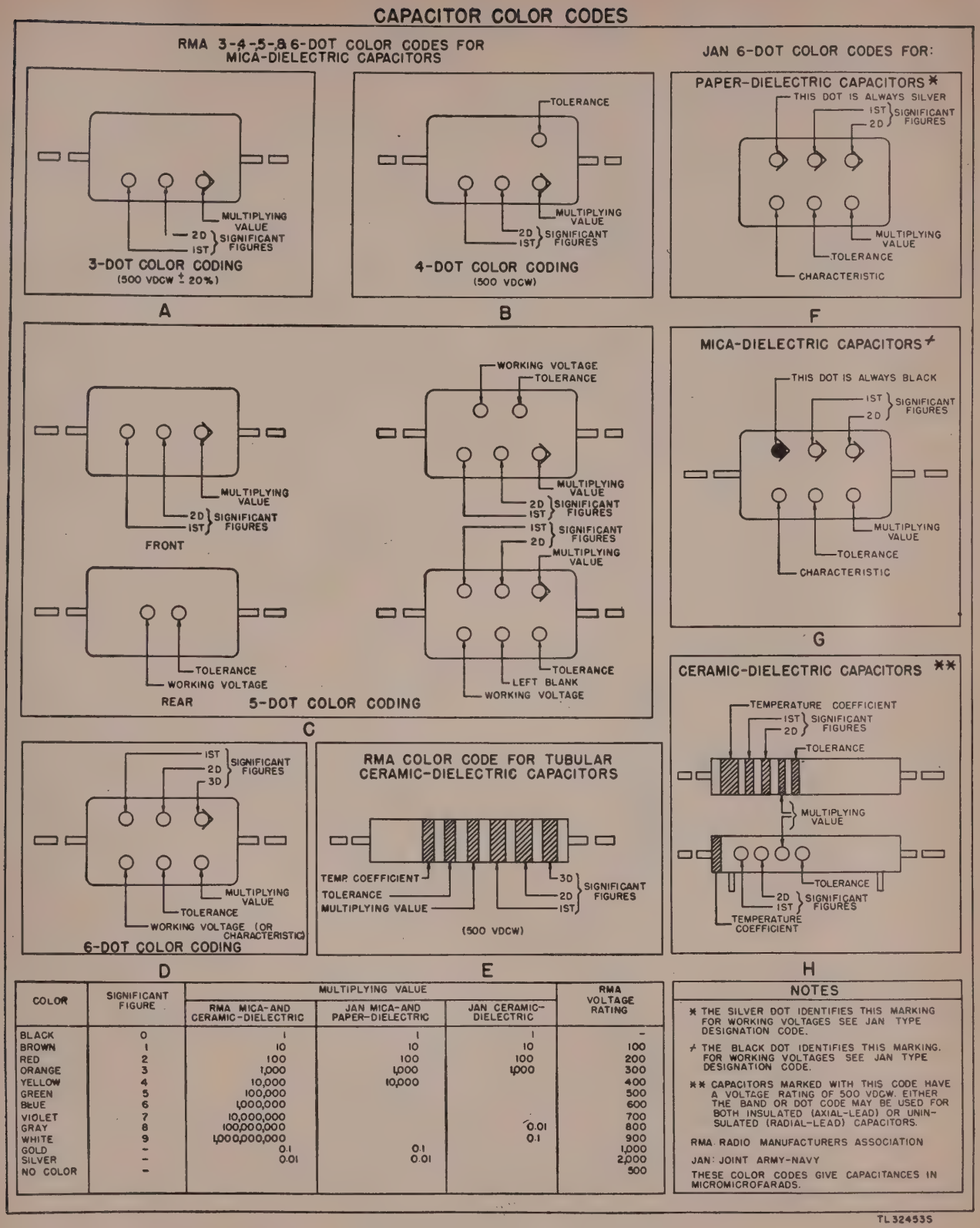
RMA RADIO MANUFACTURERS ASSOCIATION

JAN JOINT ARMY-NAVY

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS

TL32454S

Figure 67. Resistor color code.



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

≠ THE BLACK DOT IDENTIFIES THIS MARKING. FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS.

RMA: RADIO MANUFACTURERS ASSOCIATION

JAN: JOINT ARMY-NAVY

THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

TL 32453S

Figure 68. Capacitor color code.

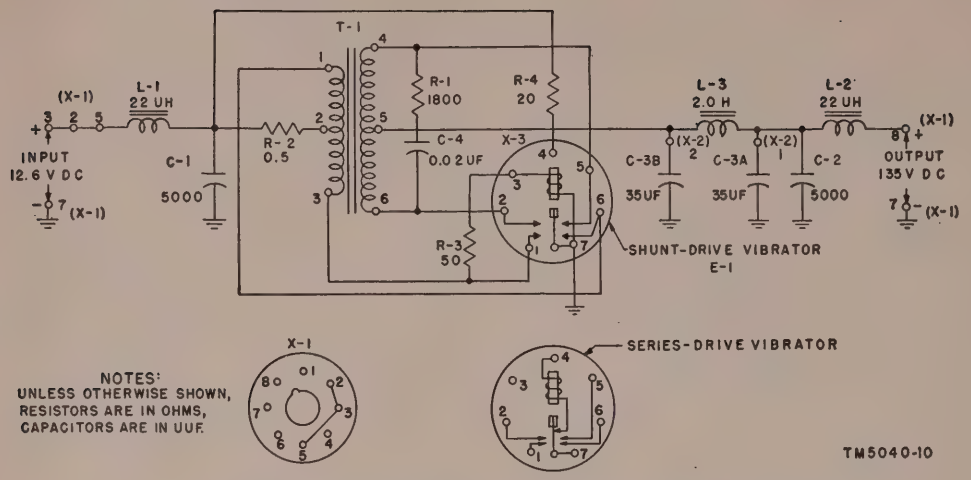


Figure 69. Power Supply PP–281/GRC, schematic diagram.

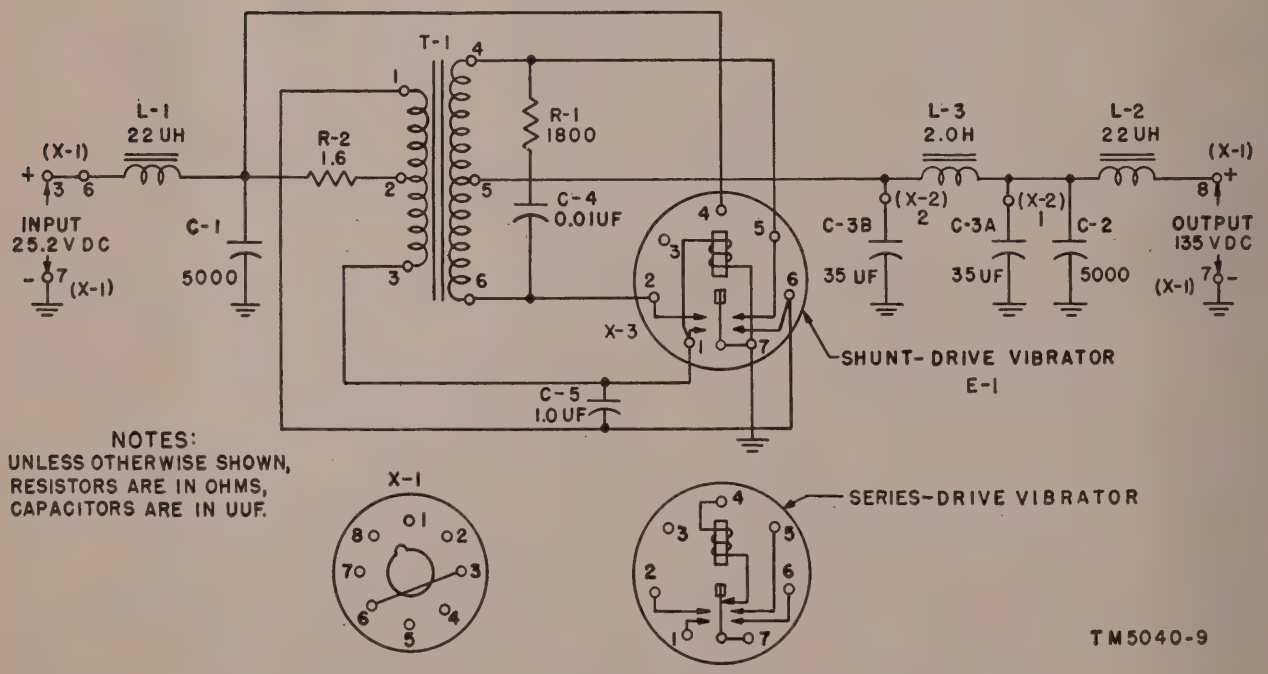


Figure 70. Power Supply PP–282/GRC, schematic diagram.

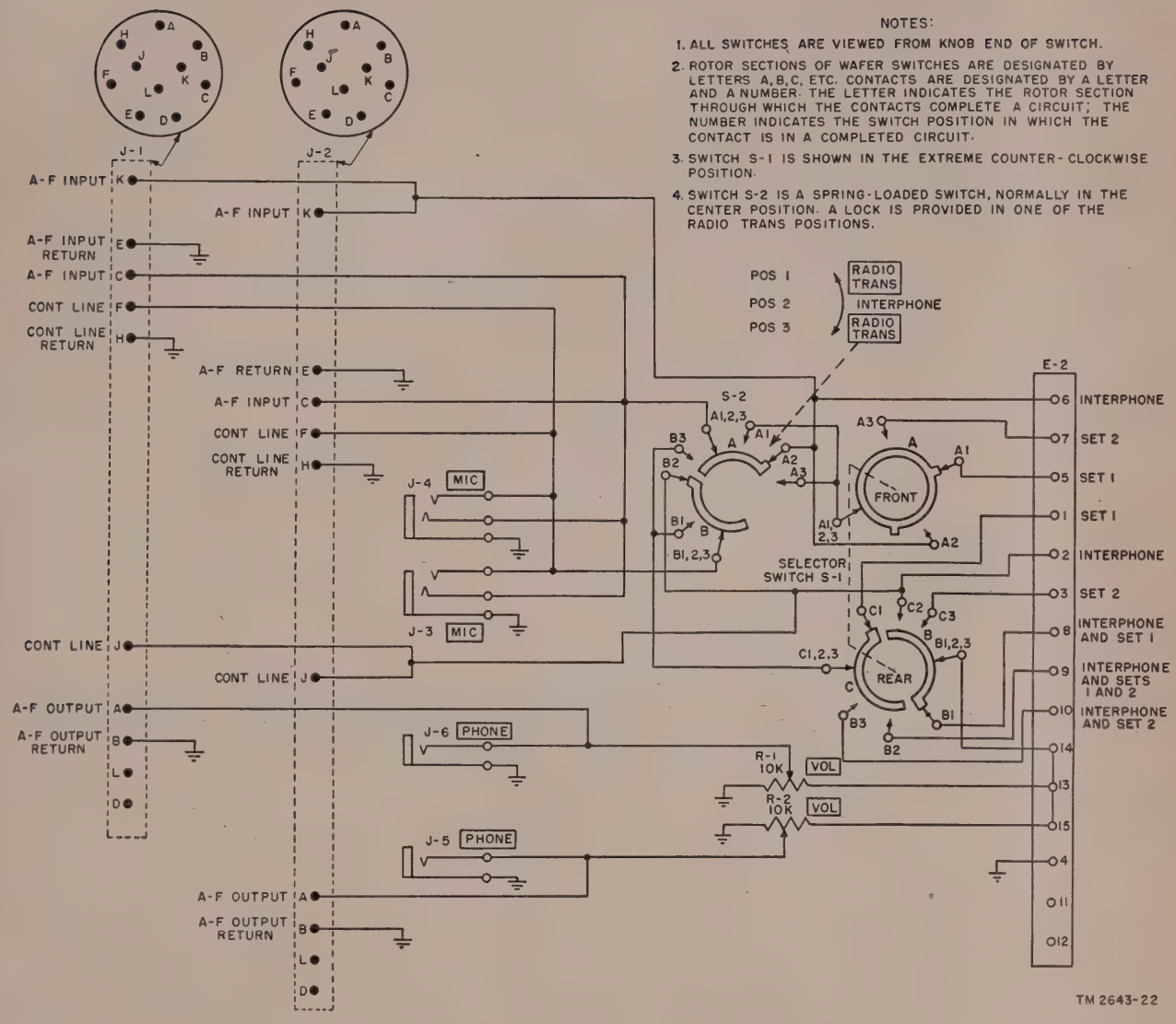


Figure 71. Control Box C-375/VRC, schematic diagram.

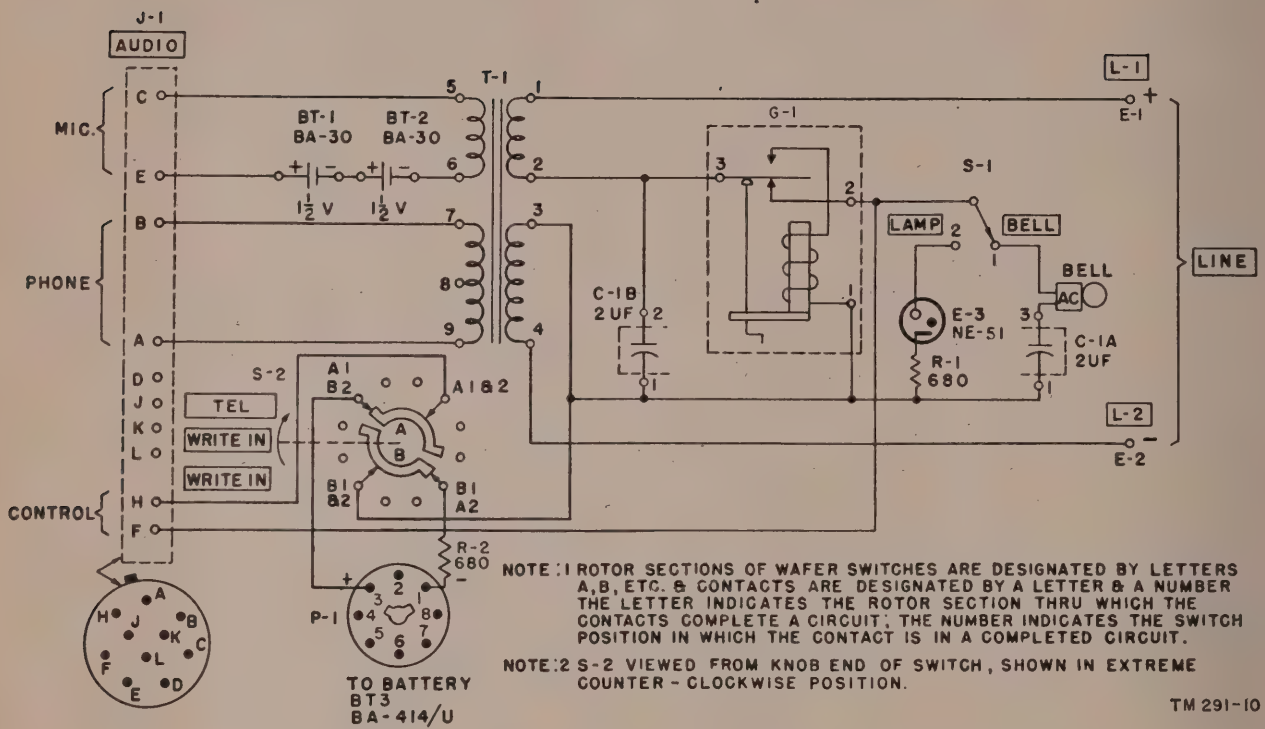


Figure 73. Remote Control C-433/GRC, schematic diagram.

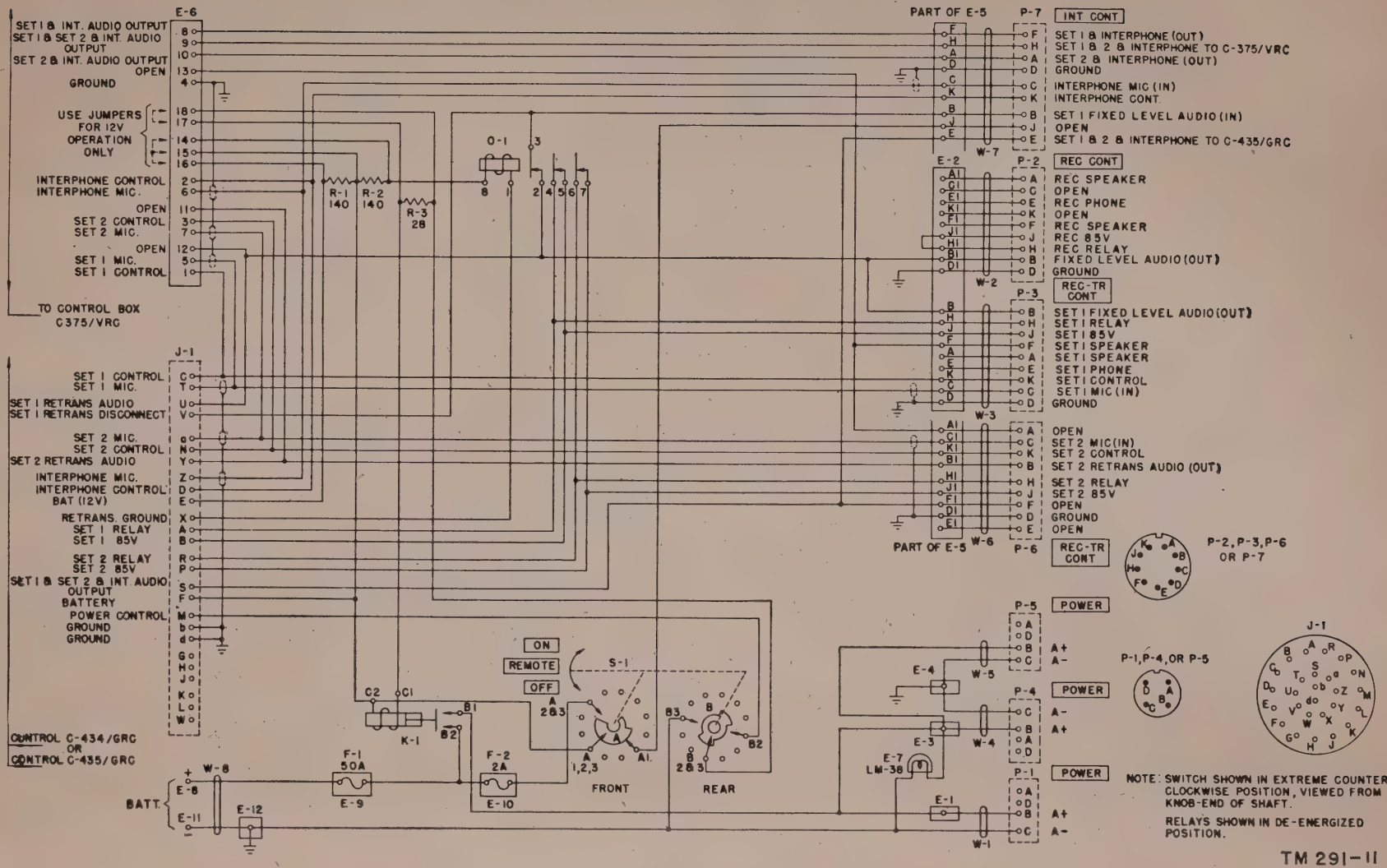


Figure 74. Mounting MT-297/GR, schematic diagram.

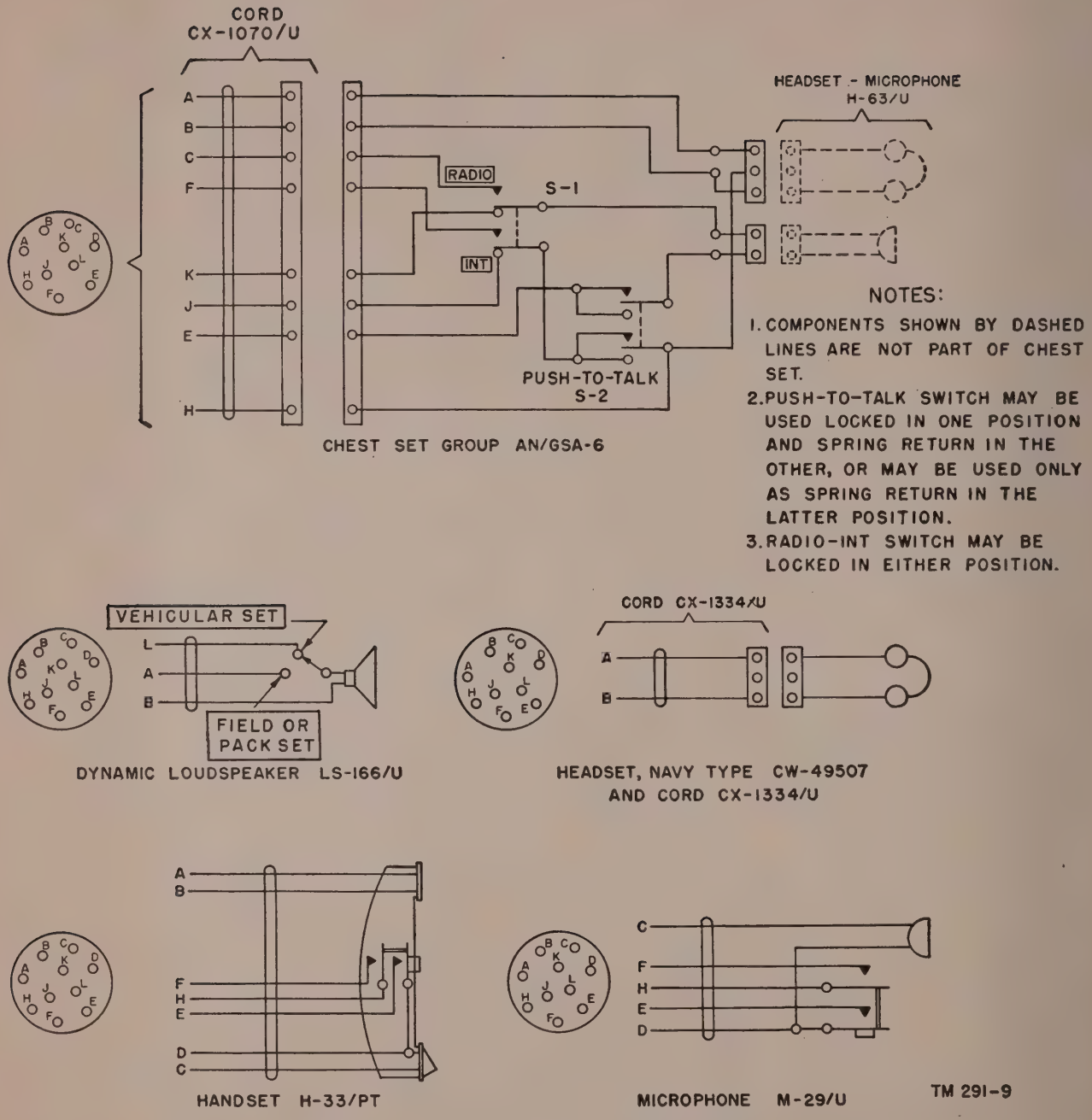


Figure 75. Audio accessories, schematic diagram.

INDEX

	Paragraph	Page
Additional equipment required	8	5
AF Amplifier AM–65/GRC. (*See* Interphone amplifier.)		
Antenna mast sections	30	27
Antenna tuning:		
Operational check	36	31
Set 1	35	30
Audio accessories:		
Description	18	12
Storing	27	25
Vehicular installation	34	30
Auxiliary equipment, general	94	82
Battery Case CY–590/GRC, operation with	98	86
Block diagram, basic system	63	50
Charts:		
Continuity for interphone box	84	69
Interphone amplifier controls and instruments	46	37
Interphone box controls and instruments	49	41
Local Control C–434/GRC, controls and instruments	50	43
Mounting controls and instruments	45	36
Remote Control C–433/GRC, controls and instruments	51	44
Set 1 channel selection	10*c*	7
Set 1 filament circuit trouble localization	87	72
Set 1 power supply controls and instruments	47	37
Set 1 receiver-transmitter	10	7
Set 1 receiver-transmitter controls and instruments	48	39
Substitute audio accessories	18*h*	17
Chest Set Group AN/GSA–6	18*b*	12
Controls and instruments:		
Chest Set Group AN/GSA–6	52	44
Interphone amplifier	46	37
Interphone box	49	41
Introduction	44	36
Local Control C–434/GRC	50	43
Mounting	45	36
Remote Control C–433/GRC	51	44
Set 1 power supply	47	36
Set 1 receiver-transmitter	48	39
Control Box C–375/VRC:		
Controls and instruments	49	41
Description	14	11
Operation	58	47
Vehicular installation	24	23
Control Group AN/GRA–6:		
Description	15	11
Equipment installation	37	31
Operation	59	47
Replacement of parts	93	76
Description, general system	9	6
Duplex telephone facilities	43	36
Dynamic Loudspeaker LS–166/U	18*d*	14
Equipment performance checklist	81*c*	65
Forms and records	3	1
Generator G–8/GRC:		
Operation of Set 1	99	87
Operation of Set 1 with battery case	98	86
Handset H–33/PT, description of	15*d*, 18*e*	12, 14
Handset Microphone H–63/U	18*c*	14
Headset Navy Type CW–49507 and Headset Cord CX–1334/U	18*g*	14
Identification table of parts	app. II	92
Interconnections	33	28
Interphone amplifier:		
Continuity chart	84*b*	69
Controls and instruments	46	37
Description	12	9
Equipment installation details	31	27
Operational facilities	41	36
Power distribution and push-to-talk control circuits	67	51
Replacement of parts	90	72
Trouble shooting, localization	85	70
Unit theory	79	62
Interphone box. (*See* Control Box C–375/VRC.)		
Local Control C–434/GRC:		
Controls and instruments	50	43
General	15*b*	11
Localizing procedures:		
Cables	86	71
General	82	67
Miscellaneous	84	69
Set 1 and Set 1 power supply	83	67
Set 1 filament circuit	87	72
Interphone amplifier and power supply	85	70
Microphone M–29/U	18*f*	14
Minor components	17	12
Modification Kit MX–898/GR:		
Components	96	82
Purpose and use	95	82

	Paragraph	Page
Monitoring:		
Operating instructions	39	36
Operation from Control Group AN/GRA–6	59*c*	47
Mounting Meat Base AB–15/GR equipment installation details	29	27
Mounting MT–297/GR:		
Controls and instruments	45	36
Description	13	9
Vehicular installation	23	19
Nomenclature	2	1
Operation:		
Miscellaneous application	61	49
Operation from Control Group AN/GRA–6	59	47
Operation from interphone box	58	47
Preliminary starting procedure	54	45
Routine starting procedure	55	45
Squelch and volume level adjustments	56	45
Stopping procedure	60	48
Tuning	57	45
Operational check	36	31
Operational procedure	53	45
Packaging:		
Auxiliary equipment	97	86
Data	7	5
Panel operation	61*b*	49
Power distribution	66	51
Power supplies:		
PP–109/GR and PP–112/GR. (*See* Set 1 power supply.)		
PP–281/GRC and PP–282/GRC	16	12
Replacement of parts, Set 1	91	74
Set 1	11	8
Set 1 and Set 1 power supply	32	28
Set 1 controls and instruments	47	37
Trouble shooting Set 1	83	67
Presetting detented channels	57*c*	46
Purpose of equipment	4	3
Push-to-talk operation:		
Local	72	56
Local operation from Control Group AN/GRA–6	59*d*	47
Operating instructions	40	36
Remote	73, 74	56, 57
Remote operation from Control Group AN/GRA–6	59*f*	48
Receiver-Transmitters RT–66/GRC and RT–68/GRC. (*See* Set 1.)		
Receiver-transmitter:		
Set 1	10	7
Unit theory	74, 78	57, 61
References	app. I	90
Related radio sets	app. III	102
Remote Control C–433/GRC:		
Controls and instruments	51	44
Facilities	42	36
General	15*c*	11
Remote power control and push-to-talk operation	74	57
Removing immersionproof cases	89	72
Replacement of parts	88	72
Ringing circuit	70	56
Routing antenna cables	25	25
Running spares	19	18
Scope:		
General	1	1
Theory of operation	62	50
Trouble shooting	80	65
Unit theory	75	58
Set 1:		
Antenna tuning	35	30
Controls and instruments	48	39
Filament-circuit trouble localization chart	87	
Low-power operation	61*a*	72
Operation with generator and battery case	98	49 86
Operation with Generator D–8/GRC	99	87
Power supply	11, 76	8, 58
Presetting	57*c*	46
Receiver-transmitter	10	7
Receiving circuits	68, 78	52, 61
Remote power control and push-to-talk operation from Control Group AN/GRA–6	59*g*	48
Replacement of parts	92	76
Transmitting circuits	69, 77	53, 58
Tuning	57	45
Unit theory	76–78	58–61
Stopping procedure	60	48
Storing of audio accessories	27	25
Storing of equipment not in use	38	35
System diagrams	64	50
System legend	65	51
Tables:		
Components	6	4
Equipment performance checklist	81*c*	65
Vehicular installation units	8	6
Technical characteristics	5	3
Telephone circuit	71	56
Telephone communication operation from Control Group AN/GRA–6	59*e*	48
Trouble shooting (localizing procedures)	82–84	67–69
Unpacking instructions:		
General	21	19
Vehicular installation	22	19
Vehicular provisions for antenna mast bases	26	25

	Paragraph	Page
Monitoring:		
Operating instructions	39	36
Operation from Control Group AN/GRA–6	59*c*	47
Mounting Meat Base AB–15/GR equipment installation details	29	27
Mounting MT–297/GR:		
Controls and instruments	45	36
Description	13	9
Vehicular installation	23	19
Nomenclature	2	1
Operation:		
Miscellaneous application	61	49
Operation from Control Group AN/GRA–6	59	47
Operation from interphone box	58	47
Preliminary starting procedure	54	45
Routine starting procedure	55	45
Squelch and volume level adjustments	56	45
Stopping procedure	60	48
Tuning	57	45
Operational check	36	31
Operational procedure	53	45
Packaging:		
Auxiliary equipment	97	86
Data	7	5
Panel operation	61*b*	49
Power distribution	66	51
Power supplies:		
PP–109/GR and PP–112/GR. (*See* Set 1 power supply.)		
PP–281/GRC and PP–282/GRC	16	12
Replacement of parts, Set 1	91	74
Set 1	11	8
Set 1 and Set 1 power supply	32	28
Set 1 controls and instruments	47	37
Trouble shooting Set 1	83	67
Presetting detented channels	57*c*	46
Purpose of equipment	4	3
Push-to-talk operation:		
Local	72	56
Local operation from Control Group AN/GRA–6	59*d*	47
Operating instructions	40	36
Remote	73, 74	56, 57
Remote operation from Control Group AN/GRA–6	59*f*	48
Receiver-Transmitters RT–66/GRC and RT–68/GRC. (*See* Set 1.)		
Receiver-transmitter:		
Set 1	10	7
Unit theory	74, 78	57, 61
References	app. I	90
Related radio sets	app. III	102
Remote Control C–433/GRC:		
Controls and instruments	51	44
Facilities	42	36
General	15*c*	11
Remote power control and push-to-talk operation	74	57
Removing immersionproof cases	89	72
Replacement of parts	88	72
Ringing circuit	70	56
Routing antenna cables	25	25
Running spares	19	18
Scope:		
General	1	1
Theory of operation	62	50
Trouble shooting	80	65
Unit theory	75	58
Set 1:		
Antenna tuning	35	30
Controls and instruments	48	39
Filament-circuit trouble localization chart	87	
Low-power operation	61*a*	72
Operation with generator and battery case	98	49 86
Operation with Generator D–8/GRC	99	87
Power supply	11, 76	8, 58
Presetting	57*c*	46
Receiver-transmitter	10	7
Receiving circuits	68, 78	52, 61
Remote power control and push-to-talk operation from Control Group AN/GRA–6	59*g*	48
Replacement of parts	92	76
Transmitting circuits	69, 77	53, 58
Tuning	57	45
Unit theory	76–78	58–61
Stopping procedure	60	48
Storing of audio accessories	27	25
Storing of equipment not in use	38	35
System diagrams	64	50
System legend	65	51
Tables:		
Components	6	4
Equipment performance checklist	81*c*	65
Vehicular installation units	8	6
Technical characteristics	5	3
Telephone circuit	71	56
Telephone communication operation from Control Group AN/GRA–6	59*e*	48
Trouble shooting (localizing procedures)	82–84	67–69
Unpacking instructions:		
General	21	19
Vehicular installation	22	19
Vehicular provisions for antenna mast bases	26	25

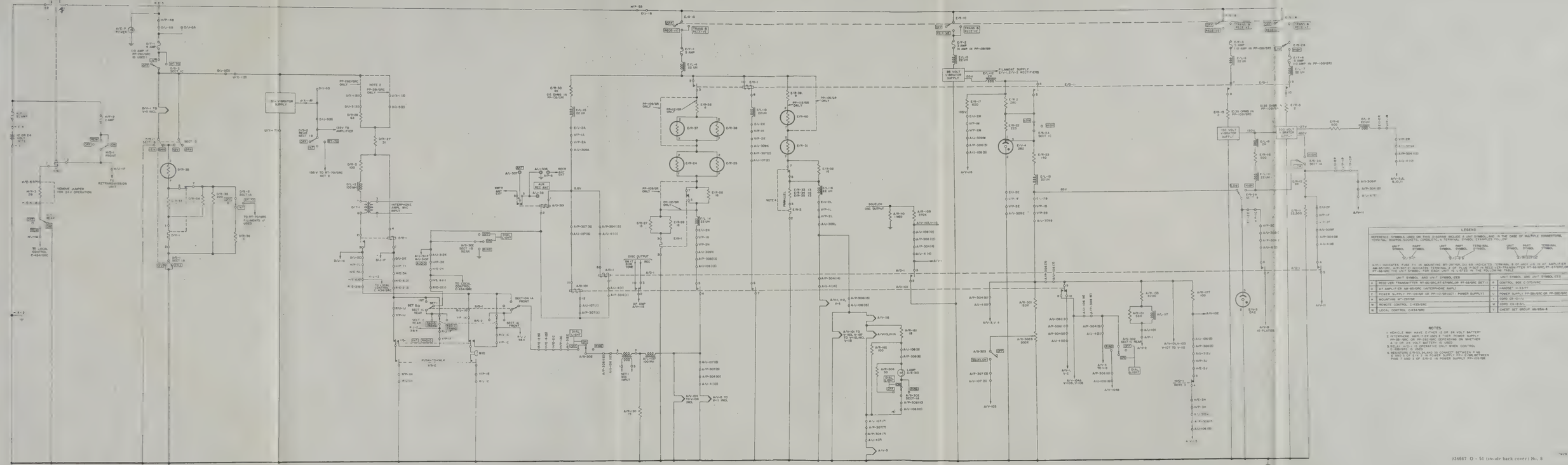
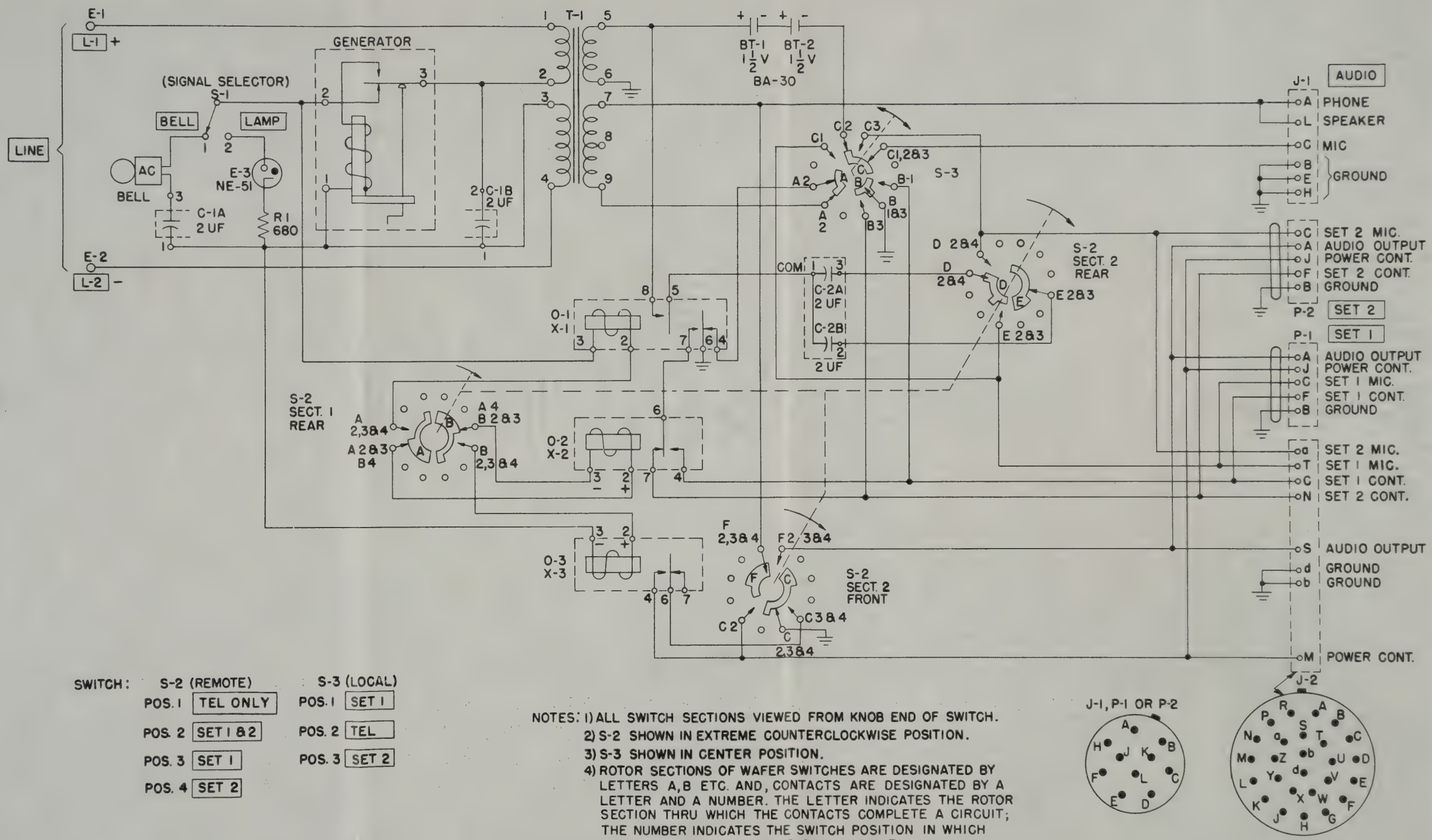


Figure 40. Power distribution and push-to-talk control circuits.



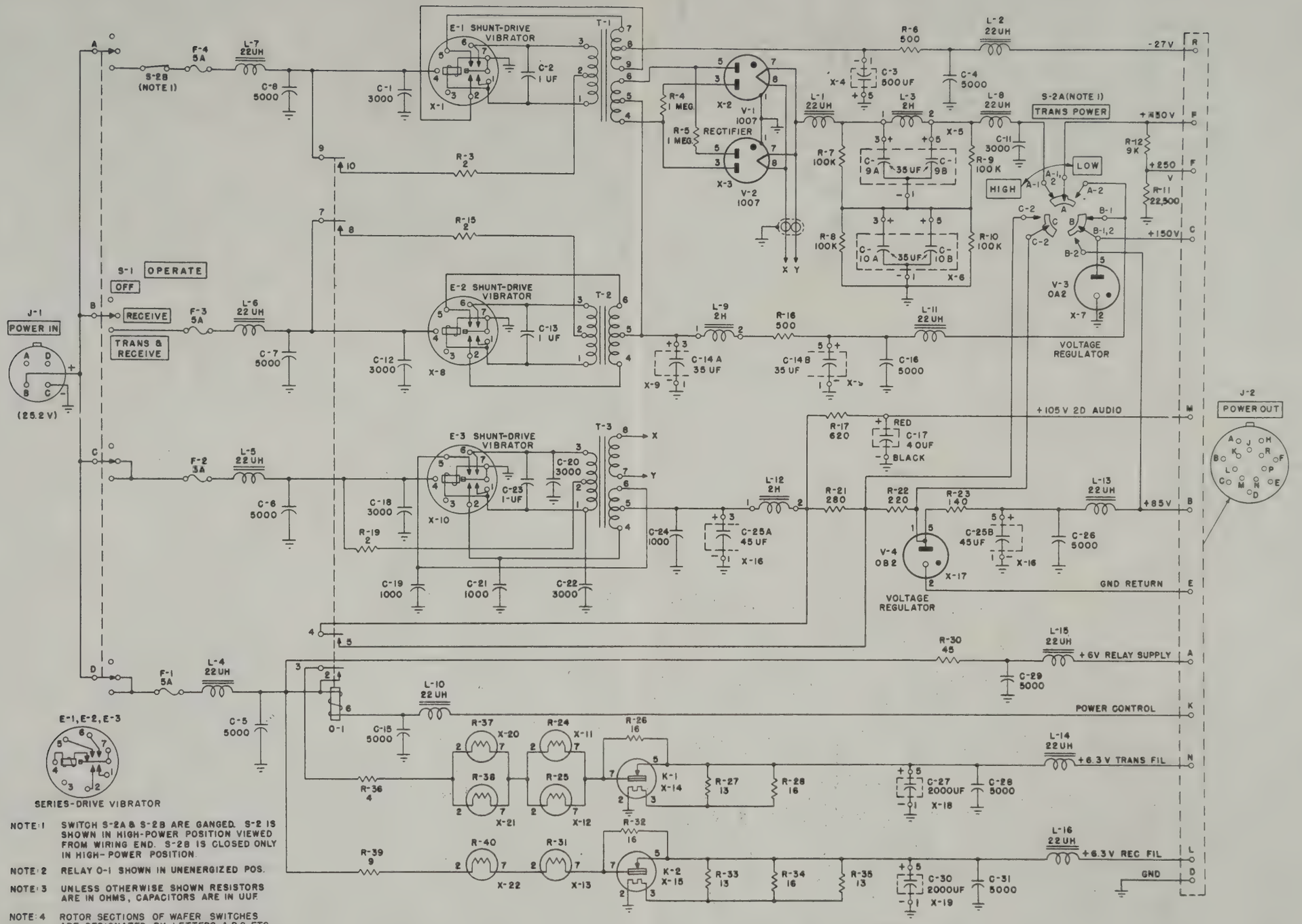
SWITCH:	S-2 (REMOTE)	S-3 (LOCAL)
POS. 1	TEL ONLY	SET 1
POS. 2	SET 1 & 2	TEL
POS. 3	SET 1	SET 2
POS. 4	SET 2	

NOTES:
1) ALL SWITCH SECTIONS VIEWED FROM KNOB END OF SWITCH.
2) S-2 SHOWN IN EXTREME COUNTERCLOCKWISE POSITION.
3) S-3 SHOWN IN CENTER POSITION.
4) ROTOR SECTIONS OF WAFER SWITCHES ARE DESIGNATED BY LETTERS A, B ETC. AND, CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THRU WHICH THE CONTACTS COMPLETE A CIRCUIT; THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT.
5) RELAY O-1 SHOWN DE-ENERGIZED
6) RELAYS O-2 AND O-3 SHOWN WITH NO OPERATING VOLTAGE APPLIED, AND LATCHED BY THE PREVIOUS APPLICATION OF A VOLTAGE OPPOSITE IN POLARITY TO THAT SHOWN ON COIL. COIL MARKINGS (+ AND −) REFER TO VOLTAGE POLARITY REQUIRED TO SWING ARMATURE TO OPEN CONTACT.

934667 O - 51 (inside back cover) No. 10

TM 284-91

Figure 72. Local Control C-434/GRC, schematic diagram.



NOTE 1 SWITCH S-2A & S-2B ARE GANGED. S-2 IS SHOWN IN HIGH-POWER POSITION VIEWED FROM WIRING END. S-2B IS CLOSED ONLY IN HIGH-POWER POSITION.

NOTE 2 RELAY O-1 SHOWN IN UNENERGIZED POS.

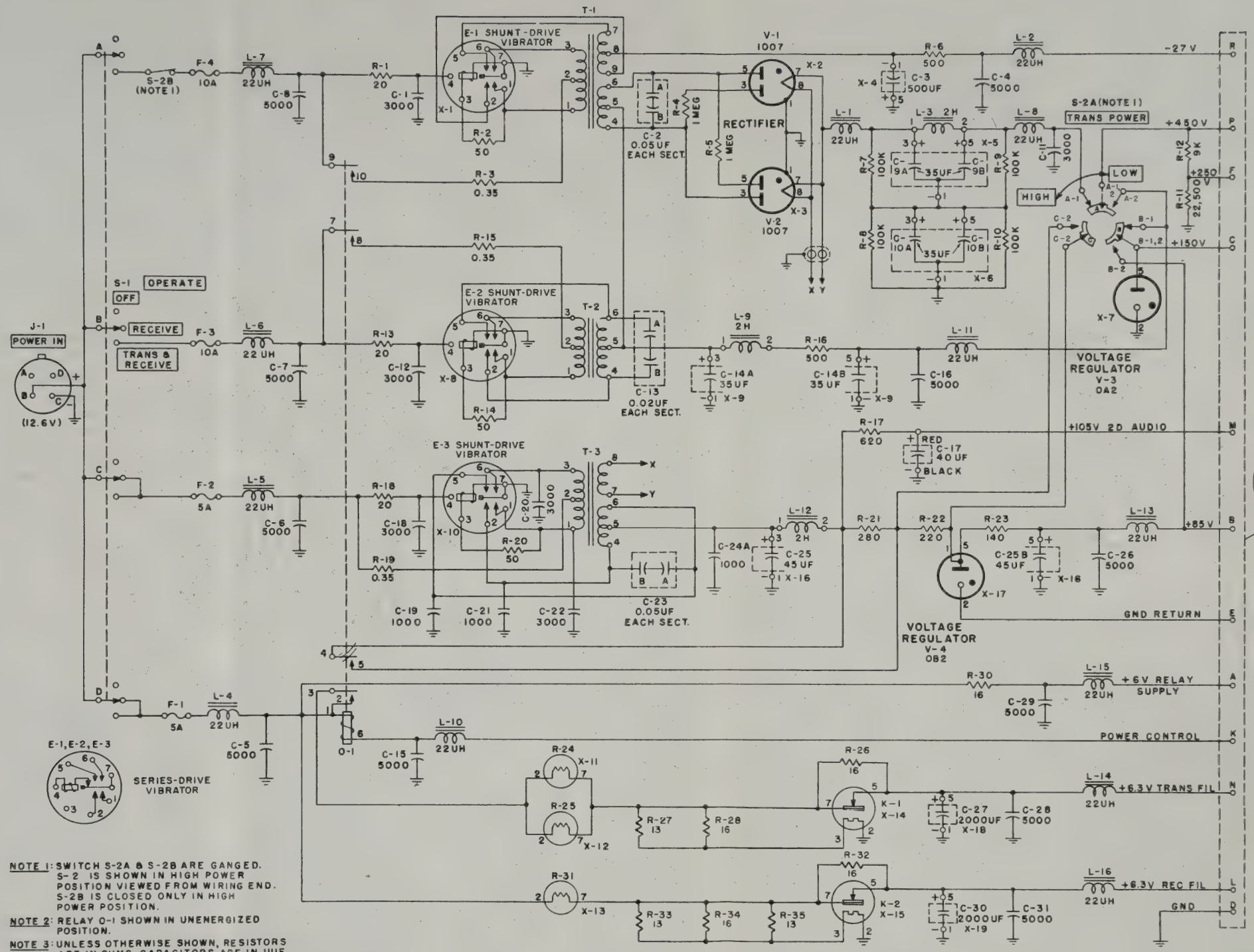
NOTE 3 UNLESS OTHERWISE SHOWN RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.

NOTE 4 ROTOR SECTIONS OF WAFER SWITCHES ARE DESIGNATED BY LETTERS A, B, C, ETC. CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THROUGH WHICH THE CONTACTS COMPLETE A CIRCUIT; THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT. THE LETTERS AND NUMBERS DO NOT APPEAR ON THE EQUIPMENT BUT ARE USED ONLY ON SCHEMATIC DIAGRAMS.

NOTE 5 VOLTAGE READINGS ARE TAKEN UNDER NORMAL LOAD CONDITIONS.

934667 O - 51 (inside back cover) No. 11

Figure 76. Power Supply PP–112/GR, schematic diagram.



NOTE 1: SWITCH S-2A & S-2B ARE GANGED. S-2 IS SHOWN IN HIGH POWER POSITION VIEWED FROM WIRING END. S-2B IS CLOSED ONLY IN HIGH POWER POSITION.

NOTE 2: RELAY O-1 SHOWN IN UNENERGIZED POSITION.

NOTE 3: UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.

NOTE 4: ROTOR SECTIONS OF WAFER SWITCHES ARE DESIGNATED BY LETTERS A, B, C, ETC. CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THROUGH WHICH THE CONTACTS COMPLETE A CIRCUIT; THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT. THE LETTERS AND NUMBERS DO NOT APPEAR ON THE EQUIPMENT BUT ARE USED ONLY ON SCHEMATIC DIAGRAMS.

NOTE 5: VOLTAGE READINGS ARE TAKEN UNDER NORMAL LOAD CONDITIONS

TM 5036-18

934667 O - 51 (inside back cover) No. 1

Figure 77. Power Supply PP–109/GR, schematic diagram.

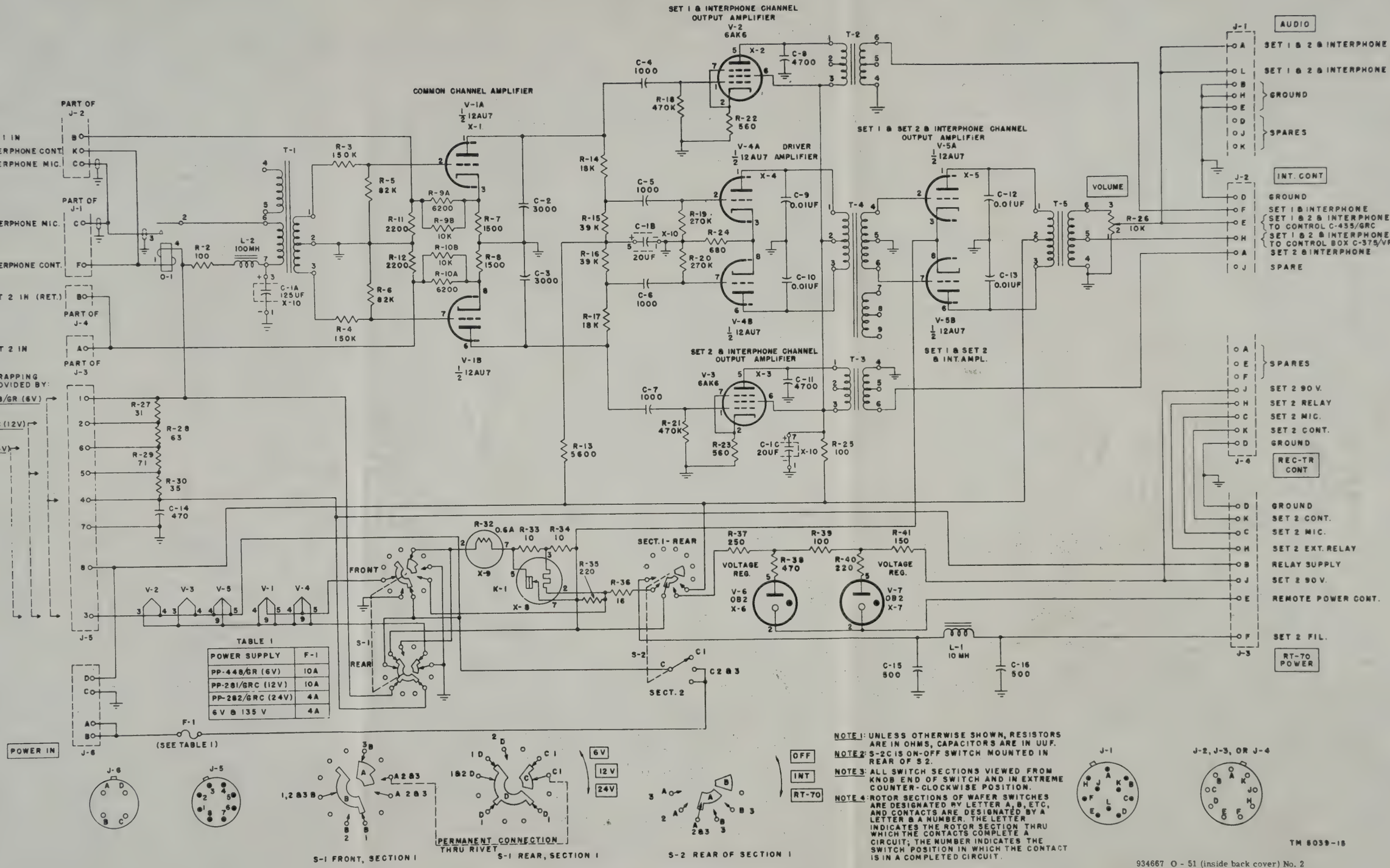


Figure 78. AF Amplifier AM-65/GRC, schematic diagram.

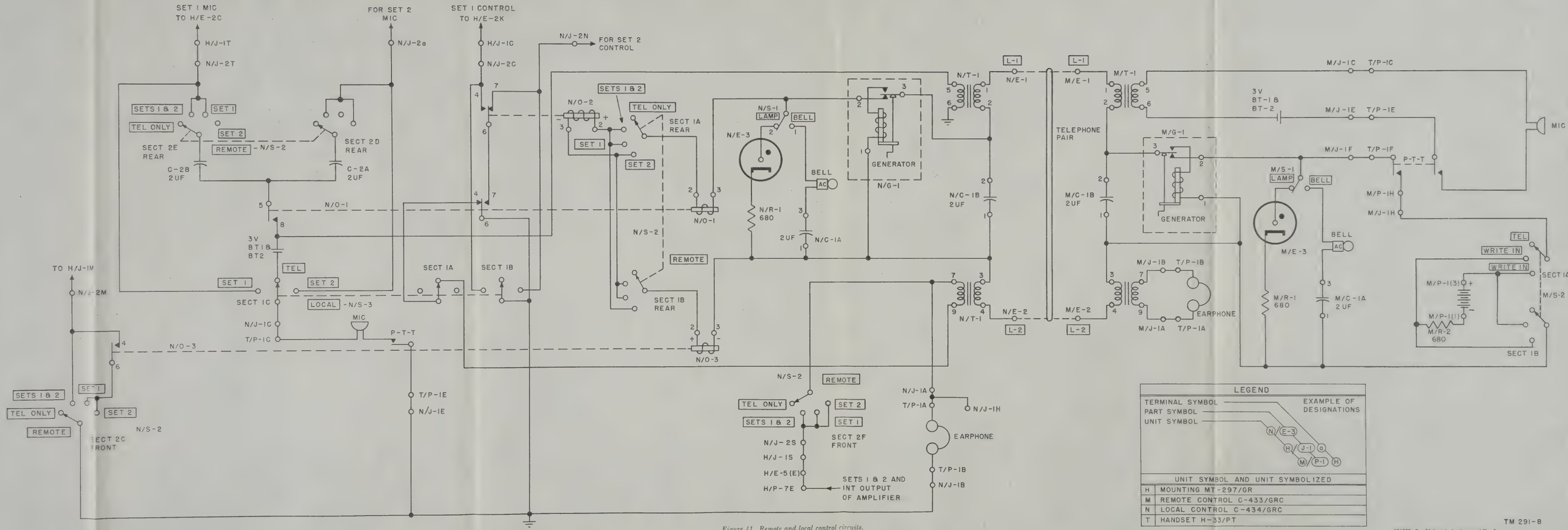
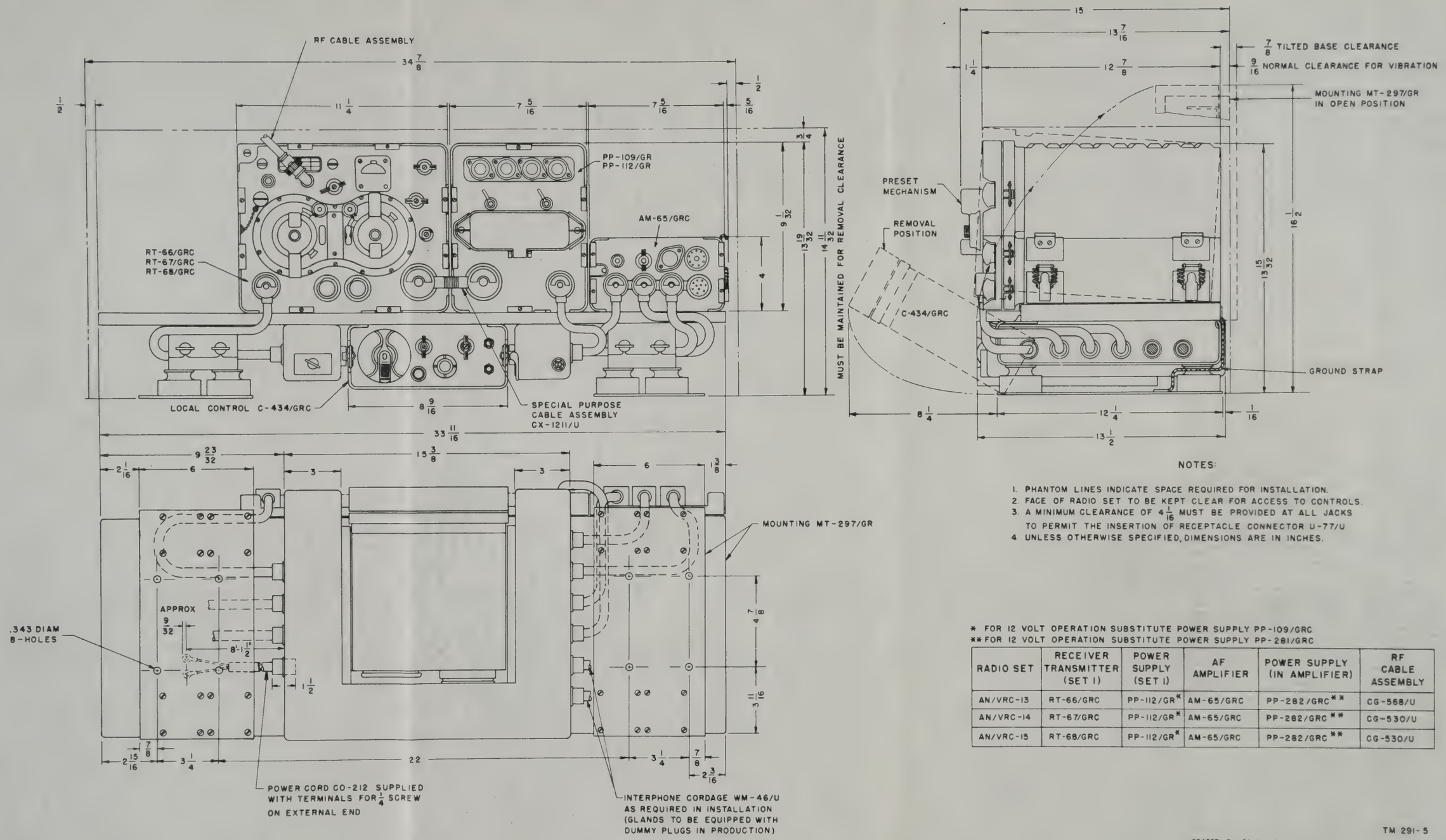


Figure 41. Remote and local control circuits.

LEGEND	
TERMINAL SYMBOL	EXAMPLE OF DESIGNATIONS
PART SYMBOL	
UNIT SYMBOL	

UNIT SYMBOL AND UNIT SYMBOLIZED	
H	MOUNTING MT-297/GR
M	REMOTE CONTROL C-433/GRC
N	LOCAL CONTROL C-434/GRC
T	HANDSET H-33/PT

934667 O - 51 (inside back cover) No. 9



NOTES:

1. PHANTOM LINES INDICATE SPACE REQUIRED FOR INSTALLATION.
2. FACE OF RADIO SET TO BE KEPT CLEAR FOR ACCESS TO CONTROLS.
3. A MINIMUM CLEARANCE OF $4\frac{1}{16}$ MUST BE PROVIDED AT ALL JACKS TO PERMIT THE INSERTION OF RECEPTACLE CONNECTOR U-77/U
4. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.

* FOR 12 VOLT OPERATION SUBSTITUTE POWER SUPPLY PP-109/GRC
** FOR 12 VOLT OPERATION SUBSTITUTE POWER SUPPLY PP-281/GRC

RADIO SET	RECEIVER TRANSMITTER (SET I)	POWER SUPPLY (SET I)	AF AMPLIFIER	POWER SUPPLY (IN AMPLIFIER)	RF CABLE ASSEMBLY
AN/VRC-13	RT-66/GRC	PP-112/GR*	AM-65/GRC	PP-282/GRC**	CG-568/U
AN/VRC-14	RT-67/GRC	PP-112/GR*	AM-65/GRC	PP-282/GRC**	CG-530/U
AN/VRC-15	RT-68/GRC	PP-112/GR*	AM-65/GRC	PP-282/GRC**	CG-530/U

Figure 18. Radio Sets AN/VRC-13 to -15, outline drawings.

934667 O - 51 (inside back cover) No. 7

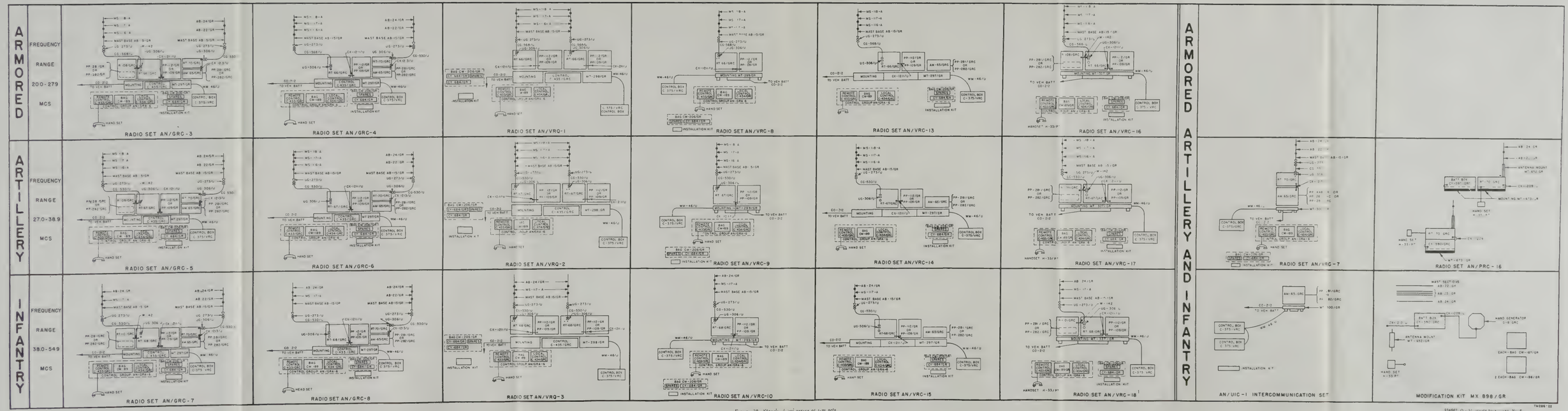


Figure 82. Standardized series of j-m sets.

934667 O-51 (double back cover) No. 6

TM286-22

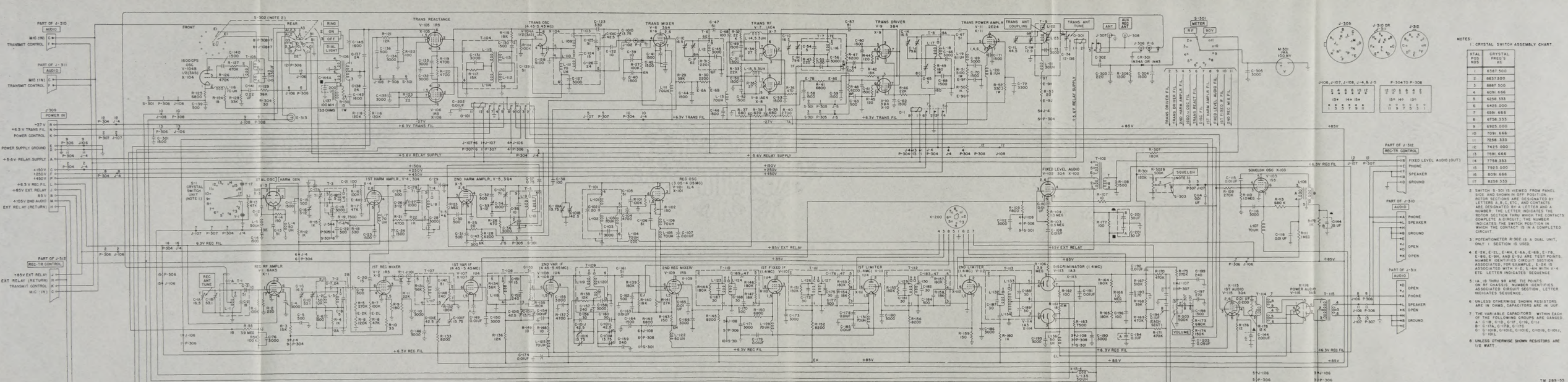


Figure 81. Receiver-Transmitter RT-68/GRC, schematic diagram.

NOTES:

1. CRYSTAL SWITCH ASSEMBLY CHART.

XTAL POS NOS	CRYSTAL FREQ'S KC
1	8387.500
2	8637.500
3	6887.500
4	6091.666
5	6258.333
6	6425.000
7	6591.666
8	6758.333
9	6925.000
10	7091.666
11	7258.333
12	7425.000
13	7591.666
14	7758.333
15	7925.000
16	8091.666
17	8258.333

2. SWITCH S-301 IS VIEWED FROM PANEL SIDE AND SHOWN IN OFF POSITION. ROTOR SECTIONS ARE DESIGNATED BY LETTERS A,B,C, ETC., AND CONTACTS ARE DESIGNATED BY A LETTER-NUMBER A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THRU WHICH THE CONTACTS COMPLETE A CIRCUIT; THE NUMBER INDICATES THE STATOR POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT.

3. POTENTIOMETER R-302 IS A DUAL UNIT; ONLY 1 SECTION IS USED.

4. E-2K, E-5L, E-4H, E-6A, E-6B, E-7B, E-8G, E-9H, AND E-9J ARE TEST POINTS. NUMBER IDENTIFIES CIRCUIT SECTION ASSOCIATED. FOR EXAMPLE, E-2K IS ASSOCIATED WITH V-2; E-4H WITH V-4. ETC. LETTER INDICATES SEQUENCE.

5. 1A, 1B THRU 9R ARE TIE POINTS ON RF CHASSIS. NUMBER IDENTIFIES ASSOCIATED CIRCUIT SECTION, LETTER INDICATES SEQUENCE.

6. UNLESS OTHERWISE SHOWN RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.

7. THE VARIABLE CAPACITORS WITHIN EACH OF THE FOLLOWING GROUPS ARE GANGED: A- C-1B, C-1D, C-1F, C-1G, C-1J. B- C-17A, C-17B, C-17C. C- C-101B, C-101D, C-101E, C-101G, C-101J, C-101L.

8. UNLESS OTHERWISE SHOWN RESISTORS ARE 1/2 WATT.

TM 288-55

924687 O - 51 (inside back cover) No. 5

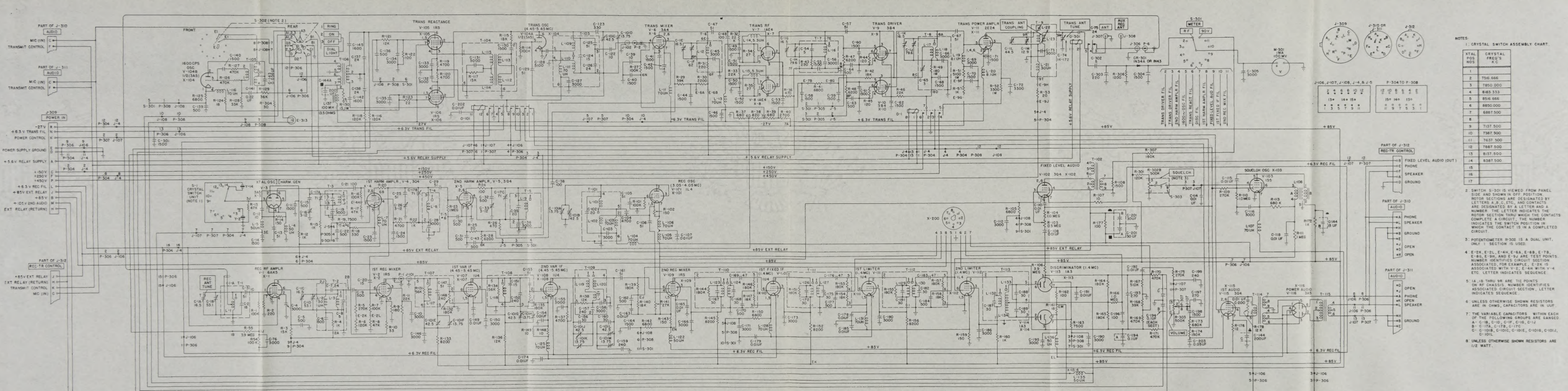


Figure 80. Receiver-Transmitter RT-67/GRC, schematic diagram.

NOTES:

1. CRYSTAL SWITCH ASSEMBLY CHART.

XTAL POS NOS	CRYSTAL FREQ'S KC
1	
2	7516.666
3	7850.000
4	8183.333
5	8516.666
6	8850.000
7	6887.500
8	
9	7137.500
10	7387.500
11	7637.500
12	7887.500
13	8137.500
14	8387.500
15	
16	
17	

2. SWITCH S-301 IS VIEWED FROM PANEL SIDE AND SHOWN IN OFF POSITION. ROTOR SECTIONS ARE DESIGNATED BY LETTERS A, B, C, ETC., AND CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THRU WHICH THE CONTACTS COMPLETE A CIRCUIT. THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT.

3. POTENTIOMETER R-302 IS A DUAL UNIT, ONLY 1 SECTION IS USED.

4. E-2K, E-2L, E-4H, E-6A, E-8B, E-7B, E-8G, E-9H, AND E-9J ARE TEST POINTS. NUMBER IDENTIFIES CIRCUIT SECTION ASSOCIATED, FOR EXAMPLE, E-2K IS ASSOCIATED WITH V-2, E-4H WITH V-4 ETC. LETTER INDICATES SEQUENCE.

5. 1A, 1B THRU 9R ARE TIE POINTS ON RF CHASSIS. NUMBER IDENTIFIES ASSOCIATED CIRCUIT SECTION, LETTER INDICATES SEQUENCE.

6. UNLESS OTHERWISE SHOWN RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.

7. THE VARIABLE CAPACITORS WITHIN EACH OF THE FOLLOWING GROUPS ARE GANGED:
A- C-1B, C-1D, C-1F, C-1G, C-1J
B- C-17A, C-17B, C-17C
C- C-101B, C-101C, C-101E, C-101G, C-101J, C-101L

8. UNLESS OTHERWISE SHOWN RESISTORS ARE 1/2 WATT.

TM 289-54

92466T O - 51 (inside back cover) No. 4

NOTES:

1. CRYSTAL SWITCH ASSEMBLY CHART

XTAL POS NOS	CRYSTAL FREQ'S KC
1	
2	7775.000
3	8275.000
4	
5	8775.000
6	
7	6183.333
8	
9	6516.666
10	
11	6850.000
12	
13	7183.333
14	7516.666
15	
16	
17	

2. SWITCH S-301 IS VIEWED FROM PANEL SIDE AND SHOWN IN OFF POSITION. ROTOR SECTIONS ARE DESIGNATED BY LETTERS A,B,C, ETC, AND CONTACTS ARE DESIGNATED BY A LETTER AND A NUMBER. THE LETTER INDICATES THE ROTOR SECTION THRU WHICH THE CONTACTS COMPLETE A CIRCUIT, THE NUMBER INDICATES THE SWITCH POSITION IN WHICH THE CONTACT IS IN A COMPLETED CIRCUIT.

3. POTENTIOMETER R-302 IS A DUAL UNIT, ONLY 1 SECTION IS USED.

4. E-2K, E-2L, E-4H, E-6A, E-6B, E-7B, E-8G, E-9H, AND E-9J ARE TEST POINTS. NUMBER IDENTIFIES CIRCUIT SECTION ASSOCIATED, FOR EXAMPLE, E-2K IS ASSOCIATED WITH V-2, E-4H WITH V-4 ETC. LETTER INDICATES SEQUENCE.

5. 1A, 1B THRU 9R ARE TIE POINTS ON RF CHASSIS. NUMBER IDENTIFIES ASSOCIATED CIRCUIT SECTION, LETTER INDICATES SEQUENCE.

6. UNLESS OTHERWISE SHOWN RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.

7. THE VARIABLE CAPACITORS WITHIN EACH OF THE FOLLOWING GROUPS ARE GANGED.
A- C-1B, C-1D, C-1F, C-1G, C-1J
B- C-17A, C-17B, C-17C
C- C-101B, C-101C, C-101E, C-101G, C-101J, C-101L

8. UNLESS OTHERWISE SHOWN RESISTORS ARE 1/2 WATT.

TM 289-53

Figure 79. Receiver-Transmitter RT-66/GRC, schematic diagram.

934667 o - 51 (inside back cover) No. 3